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# Bioassay and Chemical Analysis for Hazardous Materials in Residual Oils. Volume 2. Appendices

Westinghouse Research and Development Center
Pittsburgh, PA

Prepared for

Industrial Environmental Research Lab.
Research Triangle Park, NC

Apr 81

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# Bioassay and Chemical Analysis for Hazardous Materials in Residual Oil
## Volume 2. Appendices

T. D. Kaczmarek, et al

Westinghouse Research and Development Center
Pittsburgh, Pennsylvania

April 1981

EPA-600/7-81-080b

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# Bioassay and Chemical Analysis for Hazardous Materials in Residual Oils

## Volume 2. Appendices

by

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16. ABSTRACT
The report gives results of an examination, including mutagenic screening, of the chemical composition of residual fuel oils and their column chromatography prefractions. A degree of correlation between composition and mutagenicity has been achieved. Radionuclide data has been obtained. A novel sample processing technique has been developed for solvent partitioning followed by column chromatography. It concentrates mutagenic factors into fractions that retain their chemical class distinctions but eliminate sample components that are not of environmental concern. An as-received residual fuel oil is either non-mutagenic or only weakly mutagenic. In this respect, residual oils would not be considered environmental hazards. A residual oil can be fractionated so that fractions will be mutagenic. Some fractions from some oil samples can be strongly mutagenic. (To determine if physical or chemical processes in use or in the environment could concentrate or create mutagenicity is beyond the scope of this work.)

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| a. DESCRIPTORS | b. IDENTIFIERS/OPEN ENDED TERMS | c. COSATI Field/Group |
|---|---|---|
| Pollution | Pollution Control | 13B |
| Residual Oils | Stationary Sources | 11H |
| Toxicity | Hazardous Material | 06T |
| Chemical Analysis | | 07D |
| Bioassay | | 06A |
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# ABSTRACT

The chemical composition of residual fuel oils and their column chromatography pre-fractions have been examined and mutagenic screening of them performed. A degree of correlation between composition and mutagenicity has been achieved. Radionuclide data has been obtained. A novel sample processing technique of solvent partitioning followed by column chromatography has been developed. It concentrates mutagenic factors into fractions which still retain their chemical class distinctions while eliminating sample components that are not of environmental concern. An as received residual fuel oil is either non-mutagenic or only weakly mutagenic. In this respect residual oils would not be considered environmental hazards. A residual oil is capable of being fractionated so that fractions will be mutagenic. Some fractions from some oil samples can be strongly mutagenic. Whether physical or chemical processes in usage or in the environment could act to concentrate or create mutagenicity is beyond the scope of this contract.

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# APPENDIX A

## BIOASSAY DATA FROM LITTON BIONETICS, INC.

This Appendix contains all the reports submitted by Litton Bionetics, Inc., as part of their subcontract. To save space and cost, the test protocol has been removed and is reproduced only once in Section 5, Experimental Techniques.

These reports cover D4 and *E. coli* $WP_2$ analysis of residual oil samples RO#1 to RO#26 and nine fractions of RO#3 for a total of 36 samples bioassayed.

# MUTAGENICITY EVALUATION OF

# RO #1-26

# IN THE
# PLATE INCORPORATION ASSAYS

## FINAL REPORT

SUBMITTED TO:

WESTINGHOUSE ELECTRIC CORPORATION
BEULAK ROAD
PITTSBURG, PENNSYLVANIA 15235

SUBMITTED BY:

LITTON BIONETICS, INC.
5516 NICHOLSON LANE
KENSINGTON, MARYLAND 20795

LBI PROJECT NO. 20988

SEPTEMBER 1978

Litton BIONETICS

I. **SPONSOR:** Westinghouse Electric Corporation

II. **MATERIAL***

A. **Identification:** RO #1

B. **Date Received:** August 4, 1978

C. **Physical Description:** Dark brown liquid

III. **TYPE OF ASSAY:** Plate Incorporation Assay

IV. **PROTOCOL NO.:** Special

V. **RESULTS**

The results of this assay are presented in Table 1.

VI. **INTERPRETATION OF RESULTS AND CONCLUSIONS**

The test compound was examined for mutagenic activity in a series of in vitro microbial assays employing E. coli and Saccharomyces indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effects at the high dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.01 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

---

*Information was supplied by the sponsor. If information was not indicated by the sponsor, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound RO #1 did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 9.27.78

D. R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

9/27/78

for David Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#1
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: AUG. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|---|
| | | | | $WP_2uvrA^-$ | | D4* | |
| | | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | | |
| SOLVENT CONTROL | | --- | --- | 17 | | 76 | |
| POSITIVE CONTROL** | | --- | --- | 483 | | 1827 | |
| TEST COMPOUND | | | | | | | |
| | 0.010000 UL | --- | --- | 11 | | 67 | |
| | 0.100000 UL | --- | --- | 15 | | 63 | |
| | 1.000000 UL | --- | --- | 13 | | 69 | |
| | 5.000000 UL | --- | --- | 10 | | 77 | |
| | 10.000000 UL | --- | --- | 21 | | 65 | |
| ACTIVATION | | | | | | | |
| SOLVENT CONTROL | | RAT | LIVER | 17 | | 61 | |
| POSITIVE CONTROL*** | | RAT | LIVER | 44 + | | 59+ | |
| TEST COMPOUND | | | | | | | |
| | 0.010000 UL | RAT | LIVER | 32 | | 63 | |
| | 0.100000 UL | RAT | LIVER | 22 | | 62 | |
| | 1.000000 UL | RAT | LIVER | 19 | | 70 | |
| | 5.000000 UL | RAT | LIVER | 27 | | 61 | |
| | 10.000000 UL | RAT | LIVER | 16 | | 65 | |

---

* TRY+ CONVERTANTS PER PLATE

** $WP_2uvrA^-$ N-METHYL, N-NITRO, N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL, N-NITRO, N-NITROSOGUANIDINE 10 UG/PLATE

*** $WP_2uvrA^-$ 2-(2 FURYL)-3-(5 NITRO -2- FURYL)-ACRYLMAMIDE 10 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THESE STRAINS IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse Electric Corporation

II. MATERIAL*

A. Identification: RO #2

B. Date Received: August 4, 1978

C. Physical Description: Dark brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assays

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.01 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative. The test with the strain $WP_2$ was repeated because of a contaminated plate in the initial test.

---

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #2, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 10.17.78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

10/17/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

V. RESULTS

TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#2
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: SEP. 8, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE $WP_2uvrA^-$ 1 | $WP_2uvrA^-$ 2 | D4* 1 | D4* 2 |
|---|---|---|---|---|---|---|
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 17 | | 76 | |
| POSITIVE CONTROL** | --- | --- | 483 | | 1827 | |
| TEST COMPOUND | | | | | | |
| 0.010000 UL | --- | --- | 10 | | 67 | |
| 0.100000 UL | --- | --- | 20 | | 61 | |
| 1.000000 UL | --- | --- | 13 | | 70 | |
| 5.000000 UL | --- | --- | 12 | | 81 | |
| 10.000000 UL | --- | --- | 15 | | 89 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 17 | 11 | 61 | |
| POSITIVE CONTROL*** | RAT | LIVER | 44 | 38 | 59+ | |
| TEST COMPOUND | | | | | | |
| 0.010000 UL | RAT | LIVER | 14 | 8 | 56 | |
| 0.100000 UL | RAT | LIVER | 16 | 12 | 69 | |
| 1.000000 UL | RAT | LIVER | 20 | 5 | 70 | |
| 5.000000 UL | RAT | LIVER | C | 8 | 79 | |
| 10.000000 UL | RAT | LIVER | 19 | 7 | 47 | |

* TRY+ CONVERTANTS PER PLATE

** $WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

*** $WP_2uvrA^-$ 2-(2 FURYL)-3-(5-NITRO-2-FURYL)-ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

C = CONTAMINATION

I. SPONSOR: Westinghouse Electric Corporation

II. MATERIAL*

A. Identification: RO $\#4_1$ = RO#3

B. Date Received: August 4, 1978

C. Physical Description: Dark brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assays

IV. PROTOCOL NO.: Special

## V. RESULTS

The results of this assay are presented in Table 1.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of in vitro microbial assays employing Saccharomyces and E. coli indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.01 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative. The test with the strain $WP_2$ was repeated because of increased revertants (over the solvent control) observed in the initial test. The repeat test was also negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #41, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

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Study Director

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David Brusick 10/17/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

## TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO # $4_1$
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: AUG. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 17 | | 76 | |
| POSITIVE CONTROL** | --- | --- | 483 | | 1827 | |
| TEST COMPOUND | | | | | | |
| 0.010000 UL | --- | --- | 6 | | 83 | |
| 0.100000 UL | --- | --- | 13 | | 75 | |
| 1.000000 UL | --- | --- | 12 | | 67 | |
| 5.000000 UL | --- | --- | 18 | | 89 | |
| 10.000000 UL | --- | --- | 11 | | 80 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 17 | 11 | 61 | |
| POSITIVE CONTROL*** | RAT | LIVER | 44 | 38 | 59+ | |
| TEST COMPOUND | | | | | | |
| 0.010000 UL | RAT | LIVER | 13 | 14 | 66 | |
| 0.100000 UL | RAT | LIVER | 24 | 15 | 73 | |
| 1.000000 UL | RAT | LIVER | 92 | 11 | 79 | |
| 5.000000 UL | RAT | LIVER | 48 | 9 | 72 | |
| 10.000000 UL | RAT | LIVER | 23 | 6 | 69 | |

* TRY+ CONVERTANTS PER PLATE

** $WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

*** $WP_2uvrA^-$ 2-(2 FURYL)-3-(5 NITRO-2-FURYL)-ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse Electric Corporation

II. MATERIAL*

A. Identification: RO #4

B. Date Received: August 4, 1978

C. Physical Description: Dark brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assays

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.01 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

---

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #4, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 9.28.78
D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
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Reviewed by:

9/28/78
for David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

## TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RU#4
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: AUG. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $\text{WP}_2\underline{\text{uvrA}}^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 17 | | 76 | |
| POSITIVE CONTROL** | --- | --- | 483 | | 1827 | |
| TEST COMPOUND | | | | | | |
| 0.010000 UL | --- | --- | 16 | | 56 | |
| 0.100000 UL | --- | --- | 18 | | 61 | |
| 1.000000 UL | --- | --- | 16 | | 69 | |
| 5.000000 UL | --- | --- | 19 | | 67 | |
| 10.000000 UL | --- | --- | 13 | | 55 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 17 | | 61 | |
| POSITIVE CONTROL*** | RAT | LIVER | 44+ | | 59+ | |
| TEST COMPOUND | | | | | | |
| 0.010000 UL | RAT | LIVER | 18 | | 44 | |
| 0.100000 UL | RAT | LIVER | 16 | | 51 | |
| 1.000000 UL | RAT | LIVER | 12 | | 58 | |
| 5.000000 UL | RAT | LIVER | 19 | | 47 | |
| 10.000000 UL | RAT | LIVER | 16 | | 48 | |

* TRY+ CONVERTANTS PER PLATE

**$\text{WP}_2\underline{\text{uvrA}}^-$ N-METHYL, N-NITRO, N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL, N-NITRO, N-NITROSOGUANIDINE 10 UG/PLATE

***$\text{WP}_2\underline{\text{uvrA}}^-$ 2-(2 FURYL)-3-(5 NITRO-2-FURYL)-ACRYLAMIDE 10 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THESE STRAINS IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #5

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid with particles

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: SPECIAL

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organsims. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

---

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #5, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 11·3·78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

11/6/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

## TABLE I

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#5
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 19, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE |  |  |  |
|---|---|---|---|---|---|---|
|  |  |  | $WP_2uvrA^-$ |  | D4* |  |
|  |  |  | 1 | 2 | 1 | 2 |
| **NONACTIVATION** |  |  |  |  |  |  |
| SOLVENT CONTROL | --- | --- | 15 |  | 19 |  |
| POSITIVE CONTROL** | --- | --- | 401 |  | 613 |  |
| TEST COMPOUND |  |  |  |  |  |  |
| 0.005000 UL | --- | --- | 6 |  | 22 |  |
| 0.010000 UL | --- | --- | 7 |  | 19 |  |
| 0.100000 UL | --- | --- | 15 |  | 21 |  |
| 1.000000 UL | --- | --- | 4 |  | 41 |  |
| 5.000000 UL | --- | --- | 11 |  | 15 |  |
| 10.000000 UL | --- | --- | 7 |  | 22 |  |
| **ACTIVATION** |  |  |  |  |  |  |
| SOLVENT CONTROL | RAT | LIVER | 15 |  | 63 |  |
| POSITIVE CONTROL*** | RAT | LIVER | 426 |  | 73+ |  |
| TEST COMPOUND |  |  |  |  |  |  |
| 0.005000 UL | RAT | LIVER | 17 |  | 52 |  |
| 0.010000 UL | RAT | LIVER | 15 |  | 66 |  |
| 0.100000 UL | RAT | LIVER | 12 |  | 62 |  |
| 1.000000 UL | RAT | LIVER | 16 |  | 76 |  |
| 5.000000 UL | RAT | LIVER | 22 |  | 63 |  |
| 10.000000 UL | RAT | LIVER | 19 |  | 58 |  |

---

* TRY+ CONVERTANTS PER PLATE

| | | |
|---|---|---|
| **$WP_2uvrA^-$ | 2-NITROFLUORENE | 10 UG/PLATE |
| D4 | N-METHYL,N-NITRO,N-NITROSOGUANIDINE | 10 UG/PLATE |
| ***$WP_2uvrA^-$ | 2-(2FURYL)-3-(5-NITRO-2FURYL)-ACRYLAMIDE | 2.5 UG/PLATE |
| D4 | 2-ANTHRAMINE | 2.5 UG/PLATE |

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #6

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #6, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

**Submitted by:**

**Study Director**

for Kulbir S. Bakshi 10/27/78
D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

**Reviewed by:**

10/30/78
David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

## TABLE I

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#6
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 28 | | 14 | |
| POSITIVE CONTROL** | --- | --- | 517 | | 60 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 9 | | 14 | |
| 0.010000 UL | --- | --- | 20 | | 8 | |
| 0.100000 UL | --- | --- | 21 | | 9 | |
| 1.000000 UL | --- | --- | 14 | | 10 | |
| 5.000000 UL | --- | --- | 15 | | 6 | |
| 10.000000 UL | --- | --- | 9 | | 18 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 31 | | 18 | |
| POSITIVE CONTROL*** | RAT | LIVER | 55 | | 29+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 26 | | 19 | |
| 0.010000 UL | RAT | LIVER | 15 | | 20 | |
| 0.100000 UL | RAT | LIVER | 25 | | 15 | |
| 1.000000 UL | RAT | LIVER | 14 | | 8 | |
| 5.000000 UL | RAT | LIVER | 22 | | 17 | |
| 10.000000 UL | RAT | LIVER | 23 | | 11 | |

* TRY+ CONVERTANTS PER PLATE

| | | | | |
|---|---|---|---|---|
| **$WP_2uvrA^-$ | N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE | | ***$WP_2uvrA^-$ | 2-(2 FURYL)-3-(5-NITRO-2 FURYL) ACRYLAMIDE 2.5 UG/PLATE |
| D4 | N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE | | D4 | 2-ANTHRAMINE 2.5 UG/PLATE |

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #7

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid with particles

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: SPECIAL

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of in vitro microbial assays employing Saccharomyces and E. coli indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The test compound exhibited toxicity with the strain $WP_2uvrA^-$ at 10 µl per plate dose level.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #7, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 11·3·78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

11/6/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

V. RESULTS

## TABLE I

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#7
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 19, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|---|
| | | | | $WP_2uvrA^-$ | | D4* | |
| | | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | | |
| SOLVENT CONTROL | | --- | --- | 15 | | 19 | |
| POSITIVE CONTROL** | | --- | --- | 401 | | 613 | |
| TEST COMPOUND | | | | | | | |
| | 0.005000 UL | --- | --- | 8 | | 17 | |
| | 0.010000 UL | --- | --- | 7 | | 23 | |
| | 0.100000 UL | --- | --- | 8 | | 16 | |
| | 1.000000 UL | --- | --- | 10 | | 22 | |
| | 5.000000 UL | --- | --- | 10 | | 28 | |
| | 10.000000 UL | --- | --- | 3 | | 21 | |
| ACTIVATION | | | | | | | |
| SOLVENT CONTROL | | RAT | LIVER | 15 | | 63 | |
| POSITIVE CONTROL*** | | RAT | LIVER | 426 | | 73+ | |
| TEST COMPOUND | | | | | | | |
| | 0.005000 UL | RAT | LIVER | 22 | | 54 | |
| | 0.010000 UL | RAT | LIVER | 13 | | 55 | |
| | 0.100000 UL | RAT | LIVER | 14 | | 48 | |
| | 1.000000 UL | RAT | LIVER | 15 | | 73 | |
| | 5.000000 UL | RAT | LIVER | 20 | | 64 | |
| | 10.000000 UL | RAT | LIVER | 5 | | 55 | |

* TRY+ CONVERTANTS PER PLATE

** $WP_2uvrA^-$ 2-NITROFLUORENE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

*** $WP_2uvrA^-$ 2-(2FURYL)-3-(5-NITRO-2FURYL)-ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #8

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid with particles

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: SPECIAL

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of in vitro microbial assays employing Saccharomyces and E. coli indicator organsims. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

---

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #8, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 11·3·78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

11/6/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

V. RESULTS

TABLE I

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#8
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 19, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 15 | | 19 | |
| POSITIVE CONTROL** | --- | --- | 401 | | 613 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 11 | | 21 | |
| 0.010000 UL | --- | --- | 7 | | 28 | |
| 0.100000 UL | --- | --- | 11 | | 32 | |
| 1.000000 UL | --- | --- | 11 | | 25 | |
| 5.000000 UL | --- | --- | 5 | | 23 | |
| 10.000000 UL | --- | --- | 4 | | 19 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 15 | | 63 | |
| POSITIVE CONTROL*** | RAT | LIVER | 426 | | 73* | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 22 | | 71 | |
| 0.010000 UL | RAT | LIVER | 18 | | 48 | |
| 0.100000 UL | RAT | LIVER | 23 | | 70 | |
| 1.000000 UL | RAT | LIVER | 16 | | 72 | |
| 5.000000 UL | RAT | LIVER | 21 | | 70 | |
| 10.000000 UL | RAT | LIVER | 29 | | 66 | |

* TRY+ CONVERTANTS PER PLATE

** $WP_2uvrA^-$ 2-NITROFLUORENE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

*** $WP_2uvrA^-$ 2-(2-FURYL)-3-(5-NITRO-2FURYL)-ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

* THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #9

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid with particles

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: DMT-100

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of in vitro microbial assays employing Saccharomyces and E. coli indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative. $WP_2uvrA^-$ was repeated at 5, 10 and an additional dose of 20 µl, because of the increase observed at the 10 µl per plate dose level. D4 was repeated at the same dose levels because of the dose-related response observed over the three highest dose levels. The repeat tests were negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #9, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 11·13·78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

11/13/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

### TABLE I

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#9
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 31, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|---|
| | | | | WP$_2$uvrA$^-$ | | D4* | |
| | | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | | |
| SOLVENT CONTROL | | --- | --- | 15 | | 19 | |
| POSITIVE CONTROL** | | --- | --- | 401 | | 613 | |
| TEST COMPOUND | | | | | | | |
| | 0.005000 UL | --- | --- | 10 | | 23 | |
| | 0.010000 UL | --- | --- | 11 | | 21 | |
| | 0.100000 UL | --- | --- | 8 | | 24 | |
| | 1.000000 UL | --- | --- | 12 | | 15 | |
| | 5.000000 UL | --- | --- | 7 | | 25 | |
| | 10.000000 UL | --- | --- | 5 | | 19 | |
| **ACTIVATION** | | | | | | | |
| SOLVENT CONTROL | | RAT | LIVER | 15 | 16 | 63 | 57 |
| POSITIVE CONTROL*** | | RAT | LIVER | 426 | 744 | 73 | 46 |
| TEST COMPOUND | | | | | | | |
| | 0.005000 UL | RAT | LIVER | 18 | -- | 29 | -- |
| | 0.010000 UL | RAT | LIVER | 18 | -- | 23 | -- |
| | 0.100000 UL | RAT | LIVER | 13 | -- | 33 | -- |
| | 1.000000 UL | RAT | LIVER | 11 | -- | 32 | -- |
| | 5.000000 UL | RAT | LIVER | 6 | 21 | 40 | 51 |
| | 10.000000 UL | RAT | LIVER | 25 | 15 | 64 | 34 |
| | 20.000000 UL | RAT | LIVER | -- | 19 | -- | 8 |

* TRY+ CONVERTANTS PER PLATE

** WP$_2$uvrA$^-$ 2-NITROFLUORENE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

*** WP2uvrA$^-$ 2-(2FURYL)-3-(5NITRO-2FURYL)-ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

* THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #10

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of _in vitro_ microbial assays employing _Saccharomyces_ and _E. coli_ indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

---

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #10, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

for Kulbir S. Bakshi 10/27/78
D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

10/30/78
David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

### TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#10
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | |
| SOLVENT CONTROL | --- | --- | 28 | | 14 | |
| POSITIVE CONTROL** | --- | --- | 517 | | 60 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 19 | | 5 | |
| 0.010000 UL | --- | --- | 19 | | 10 | |
| 0.100000 UL | --- | --- | 18 | | 7 | |
| 1.000000 UL | --- | --- | 29 | | 7 | |
| 5.000000 UL | --- | --- | 21 | | 19 | |
| 10.000000 UL | --- | --- | 24 | | 11 | |
| ACTIVATION | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 31 | | 18 | |
| POSITIVE CONTROL*** | RAT | LIVER | 55 | | 29+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 18 | | 6 | |
| 0.010000 UL | RAT | LIVER | 16 | | 15 | |
| 0.100000 UL | RAT | LIVER | 25 | | 17 | |
| 1.000000 UL | RAT | LIVER | 23 | | 11 | |
| 5.000000 UL | RAT | LIVER | 28 | | 25 | |
| 10.000000 UL | RAT | LIVER | 23 | | 19 | |

---

* TRY+ CONVERTANTS PER PLATE

** $WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

*** $WP_2uvrA$- 2-(2 FURYL)-3-(5-NITRO-2-FURYL) ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #11

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #11, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

for Kulbir S. Bakshi 10/27/78
D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

10/30/78
David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

### TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RU#11
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | |
| SOLVENT CONTROL | --- | --- | 19 | | 11 | |
| POSITIVE CONTROL** | --- | --- | 765 | | 200 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 8 | | 9 | |
| 0.010000 UL | --- | --- | 20 | | 12 | |
| 0.100000 UL | --- | --- | 18 | | 6 | |
| 1.000000 UL | --- | --- | 14 | | 13 | |
| 5.000000 UL | --- | --- | 14 | | 10 | |
| 10.000000 UL | --- | --- | 16 | | 14 | |
| ACTIVATION | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 27 | | 18 | |
| POSITIVE CONTROL*** | RAT | LIVER | 59 | | 44+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 17 | | 15 | |
| 0.010000 UL | RAT | LIVER | 21 | | 8 | |
| 0.100000 UL | RAT | LIVER | 28 | | 20 | |
| 1.000000 UL | RAT | LIVER | 26 | | 27 | |
| 5.000000 UL | RAT | LIVER | 29 | | 17 | |
| 10.000000 UL | RAT | LIVER | 21 | | 8 | |

---

* TRY+ CONVERTANTS PER PLATE

| | | | | |
|---|---|---|---|---|
| **$WP_2uvrA^-$ | N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE | | ***$WP_2uvrA^-$ | 2-(2 FURYL)-3-(5-NITRO-2 FURYL) ACRYLAMIDE 2,5 UG/PLATE |
| D4 | N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE | | D4 | 2-ANTHRAMINE 2.5 UG/PLATE |

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #12

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

---

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #12, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

for Kulbir S. Bakshi
D.R. Jagannath, Ph.D.
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

10/27/78
Date

Reviewed by:

David J. Brusick, Ph.D.
Director
Department of Genetics
and Cell Biology

10/30/78
Date

## V. RESULTS

### TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#12
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 19 | | 11 | |
| POSITIVE CONTROL** | --- | --- | 765 | | 200 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 18 | | 13 | |
| 0.010000 UL | --- | --- | 13 | | 12 | |
| 0.100000 UL | --- | --- | 12 | | 9 | |
| 1.000000 UL | --- | --- | 18 | | 16 | |
| 5.000000 UL | --- | --- | 10 | | 15 | |
| 10.000000 UL | --- | --- | 21 | | 11 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 27 | | 18 | |
| POSITIVE CONTROL*** | RAT | LIVER | 59 | | 44+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 15 | | 16 | |
| 0.010000 UL | RAT | LIVER | 18 | | 28 | |
| 0.100000 UL | RAT | LIVER | 25 | | 12 | |
| 1.000000 UL | RAT | LIVER | 20 | | 30 | |
| 5.000000 UL | RAT | LIVER | 22 | | 19 | |
| 10.000000 UL | RAT | LIVER | 30 | | 22 | |

* TRY+ CONVERTANTS PER PLATE

| | | |
|---|---|---|
| **$WP_2uvrA^-$ | N-METHYL,N-NITRO,N-NITROSOGUANIDINE | 10 UG/PLATE |
| D4 | N-METHYL,N-NITRO,N-NITROSOGUANIDINE | 10 UG/PLATE |
| ***$WP_2uvrA$- | 2-(2 FURYL)-3-(5-NITRO-2 FURYL)-ACRYLAMIDE | 2.5 UG/PLATE |
| D4 | 2-ANTHRAMINE | 2.5 UG/PLATE |

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #13

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

---

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #13, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

for Kulbir S. Bakshi 10/27/78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

David Brusick 10/30/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

### TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#13
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 28 | | 14 | |
| POSITIVE CONTROL** | --- | --- | 517 | | 60 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 16 | | 7 | |
| 0.010000 UL | --- | --- | 25 | | 6 | |
| 0.100000 UL | --- | --- | 21 | | 10 | |
| 1.000000 UL | --- | --- | 21 | | 12 | |
| 5.000000 UL | --- | --- | 22 | | 9 | |
| 10.000000 UL | --- | --- | 17 | | 7 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 31 | | 18 | |
| POSITIVE CONTROL*** | RAT | LIVER | 55 | | 29+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 27 | | 23 | |
| 0.010000 UL | RAT | LIVER | 22 | | 19 | |
| 0.100000 UL | RAT | LIVER | 25 | | 13 | |
| 1.000000 UL | RAT | LIVER | 19 | | 8 | |
| 5.000000 UL | RAT | LIVER | 22 | | 8 | |
| 10.000000 UL | RAT | LIVER | 16 | | 6 | |

---

* TRY+ CONVERTANTS PER PLATE

**$WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

***$WP_2uvrA^-$ 2-(2 FURYL)-3-(5-NITRO-2 FURYL) ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. **SPONSOR:** Westinghouse

II. **MATERIAL***

A. Identification: RO #14

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid

III. **TYPE OF ASSAY:** Plate Incorporation Assay

IV. **PROTOCOL NO.:** Special

V. **RESULTS**

The results of this assay are presented in Table 1.

VI. **INTERPRETATION OF RESULTS AND CONCLUSIONS**

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #14, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

for Kulbir S. Bakshi 10/27/78
D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

David Brusick 10/30/78
David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

### TABLE I

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#14
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 28 | | 14 | |
| POSITIVE CONTROL** | --- | --- | 517 | | 60 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 15 | | 12 | |
| 0.010000 UL | --- | --- | 24 | | 11 | |
| 0.100000 UL | --- | --- | 24 | | 5 | |
| 1.000000 UL | --- | --- | 19 | | 11 | |
| 5.000000 UL | --- | --- | 22 | | 13 | |
| 10.000000 UL | --- | --- | 11 | | 11 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 31 | | 18 | |
| POSITIVE CONTROL*** | RAT | LIVER | 55 | | 29+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 17 | | 14 | |
| 0.010000 UL | RAT | LIVER | 28 | | 9 | |
| 0.100000 UL | RAT | LIVER | 28 | | 30 | |
| 1.000000 UL | RAT | LIVER | 24 | | 13 | |
| 5.000000 UL | RAT | LIVER | 27 | | 11 | |
| 10.000000 UL | RAT | LIVER | 21 | | 26 | |

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* TRY+ CONVERTANTS PER PLATE.

** $WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

*** $WP_2uvrA^-$ 2-(2 FURYL)-3-(5-NITRO-2 FURYL) ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #15

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: SPECIAL

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative. D4 was repeated at 5, 10 and an additional dose level because of the increase in the number of convertants observed at the 5 and 10 µl dose level. The repeat test was also negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #15, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 11·3·78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

David Brusick 11/6/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

## TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#15
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 24, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 28 | | 14 | |
| POSITIVE CONTROL** | --- | --- | 517 | | 60 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 14 | | 12 | |
| 0.010000 UL | --- | --- | 18 | | 10 | |
| 0.100000 UL | --- | --- | 20 | | 9 | |
| 1.000000 UL | --- | --- | 18 | | 8 | |
| 5.000000 UL | --- | --- | 14 | | 12 | |
| 10.000000 UL | --- | --- | 26 | | 11 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 31 | | 18 | 74 |
| POSITIVE CONTROL*** | RAT | LIVER | 55 | | 29+ | 84 |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 24 | | 8 | — |
| 0.010000 UL | RAT | LIVER | 24 | | 10 | — |
| 0.100000 UL | RAT | LIVER | 27 | | 28 | — |
| 1.000000 UL | RAT | LIVER | 20 | | 9 | — |
| 5.000000 UL | RAT | LIVER | 30 | | 33 | 72 |
| 10.000000 UL | RAT | LIVER | 32 | | 35 | 64 |
| 20.000000 UL | RAT | LIVER | — | | — | 61 |

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* TRY+ CONVERTANTS PER PLATE

**$WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

**$WP_2uvrA^-$ 2-(2FURYL)-3-(5-NITRO-2-2FURYL)-ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #16

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #16, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

10/27/78
D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

10/30/78
David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

## TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#16
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 28 | | 14 | |
| POSITIVE CONTROL** | --- | --- | 517 | | 60 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 17 | | 18 | |
| 0.010000 UL | --- | --- | 19 | | 18 | |
| 0.100000 UL | --- | --- | 22 | | 10 | |
| 1.000000 UL | --- | --- | 19 | | 9 | |
| 5.000000 UL | --- | --- | 17 | | 13 | |
| 10.000000 UL | --- | --- | 34 | | 10 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 31 | | 18 | |
| POSITIVE CONTROL*** | RAT | LIVER | 55 | | 29+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 14 | | 16 | |
| 0.010000 UL | RAT | LIVER | 21 | | 14 | |
| 0.100000 UL | RAT | LIVER | 16 | | 19 | |
| 1.000000 UL | RAT | LIVER | 29 | | 22 | |
| 5.000000 UL | RAT | LIVER | 17 | | 29 | |
| 10.000000 UL | RAT | LIVER | 19 | | 17 | |

---

* TRY+ CONVERTANTS PER PLATE

** $WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

*** $WP_2uvrA^-$ 2-(2 FURYL)-3-(5-NITRO-2 FURYL) ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #17

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid with particles

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: SPECIAL

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organsims. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #17, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 11.3.78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

11/6/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

## TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: KO#17
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 19, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | |
| SOLVENT CONTROL | --- | --- | 15 | | 19 | |
| POSITIVE CONTROL** | --- | --- | 401 | | 613 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 7 | | 23 | |
| 0.010000 UL | --- | --- | 8 | | 33 | |
| 0.100000 UL | --- | --- | 5 | | 13 | |
| 1.000000 UL | --- | --- | 4 | | 19 | |
| 5.000000 UL | --- | --- | 15 | | 23 | |
| 10.000000 UL | --- | --- | 9 | | 28 | |
| ACTIVATION | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 15 | | 57 | |
| POSITIVE CONTROL*** | RAT | LIVER | 426 | | 73+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 12 | | 52 | |
| 0.010000 UL | RAT | LIVER | 11 | | 57 | |
| 0.100000 UL | RAT | LIVER | 16 | | 49 | |
| 1.000000 UL | RAT | LIVER | 15 | | 48 | |
| 5.000000 UL | RAT | LIVER | 7 | | 55 | |
| 10.000000 UL | RAT | LIVER | 21 | | 47 | |

* TRY+ CONVERTANTS PER PLATE

| | | | |
|---|---|---|---|
| **$WP_2uvrA^-$ | 2-NITROFLUORENE | 10 UG/PLATE | |
| D4 | N-METHYL,N-NITRO,N-NITROSOGUANIDINE | 10 UG/PLATE | |
| ***$WP_2uvrA^-$ | 2-(2FURYL)-3-(5-NITRO-2FURYL)-ACRYLAMIDE | 2.5 UG/PLATE | |
| D4 | 2-ANTHRAMINE | 2.5 UG/PLATE | |

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #18

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

## V. RESULTS

The results of this assay are presented in Table 1.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #18, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

for D.R. Jagannath, Ph.D. 10/27/78
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology
Date

Reviewed by:

David J. Brusick, Ph.D. 10/30/78
Director
Department of Genetics
and Cell Biology
Date

## V. RESULTS

## TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#18
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|---|
| | | | | $WP_2uvrA^-$ | | D4* | |
| | | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | | |
| SOLVENT CONTROL | | --- | --- | 28 | | 14 | |
| POSITIVE CONTROL** | | --- | --- | 517 | | 60 | |
| TEST COMPOUND | | | | | | | |
| | 0.005000 UL | --- | --- | 12 | | 8 | |
| | 0.010000 UL | --- | --- | 9 | | 15 | |
| | 0.100000 UL | --- | --- | 17 | | 5 | |
| | 1.000000 UL | --- | --- | 14 | | 13 | |
| | 5.000000 UL | --- | --- | 17 | | 18 | |
| | 10.000000 UL | --- | --- | 20 | | 10 | |
| ACTIVATION | | | | | | | |
| SOLVENT CONTROL | | RAT | LIVER | 31 | | 18 | |
| POSITIVE CONTROL*** | | RAT | LIVER | 55 | | 29+ | |
| TEST COMPOUND | | | | | | | |
| | 0.005000 UL | RAT | LIVER | 32 | | 14 | |
| | 0.010000 UL | RAT | LIVER | 23 | | 17 | |
| | 0.100000 UL | RAT | LIVER | 17 | | 18 | |
| | 1.000000 UL | RAT | LIVER | 22 | | 24 | |
| | 5.000000 UL | RAT | LIVER | 25 | | 19 | |
| | 10.000000 UL | RAT | LIVER | 23 | | 19 | |

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* TRY+ CONVERTANTS PER PLATE

| | | | |
|---|---|---|---|
| **$WP_2uvrA^-$ | N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE | ***$WP_2uvrA^-$ | 2-(2 FURYL)-3-(5-NITRO-2 FURYL) ACRYLAMIDE 2,5 UG/PLATE |
| D4 | N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE | D4 | 2-ANTHRAMINE 2.5 UG/PLATE |

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #19

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of _in vitro_ microbial assays employing _Saccharomyces_ and _E. coli_ indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #19, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

for Kulbir S. Bakshi 10/27/78
D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

David Brusick 10/30/78
David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

V. RESULTS

TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#19
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | |
| SOLVENT CONTROL | --- | --- | 28 | | 14 | |
| POSITIVE CONTROL** | --- | --- | 517 | | 60 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 12 | | 5 | |
| 0.010000 UL | --- | --- | 9 | | 5 | |
| 0.100000 UL | --- | --- | 14 | | 6 | |
| 1.000000 UL | --- | --- | 17 | | 11 | |
| 5.000000 UL | --- | --- | 15 | | 10 | |
| 10.000000 UL | --- | --- | 21 | | 11 | |
| ACTIVATION | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 18 | | 18 | |
| POSITIVE CONTROL*** | RAT | LIVER | 55 | | 29+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 14 | | 14 | |
| 0.010000 UL | RAT | LIVER | 13 | | 11 | |
| 0.100000 UL | RAT | LIVER | 19 | | 18 | |
| 1.000000 UL | RAT | LIVER | 19 | | 20 | |
| 5.000000 UL | RAT | LIVER | 16 | | 10 | |
| 10.000000 UL | RAT | LIVER | 16 | | 9 | |

---

* TRY+ CONVERTANTS PER PLATE

**$WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

***$WP_2uvrA^-$ 2-(2 FURYL)-3-(5-NITRO-2 FURYL) ACRILAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #20

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

---

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #20, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

for Kulbir S. Bakshi 10/27/78
D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

10/30/78
David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

V. RESULTS

TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RU#20
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | |
| SOLVENT CONTROL | --- | --- | 28 | | 14 | |
| POSITIVE CONTROL** | --- | --- | 517 | | 60 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 16 | | 11 | |
| 0.010000 UL | --- | --- | 16 | | 11 | |
| 0.100000 UL | --- | --- | 15 | | 18 | |
| 1.000000 UL | --- | --- | 21 | | 13 | |
| 5.000000 UL | --- | --- | 16 | | 17 | |
| 10.000000 UL | --- | --- | 24 | | 12 | |
| ACTIVATION | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 31 | | 18 | |
| POSITIVE CONTROL*** | RAT | LIVER | 55 | | 29+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 25 | | 15 | |
| 0.010000 UL | RAT | LIVER | 17 | | 11 | |
| 0.100000 UL | RAT | LIVER | 11 | | 23 | |
| 1.000000 UL | RAT | LIVER | 26 | | 24 | |
| 5.000000 UL | RAT | LIVER | 24 | | 22 | |
| 10.000000 UL | RAT | LIVER | 18 | | 17 | |

* TRY+ CONVERTANTS PER PLATE

** $WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

*** $WP_2uvrA$- 2-(2-FURYL)-3-(5-NITRO-2-FURYL) ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #21

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid with particles

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: SPECIAL

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of in vitro microbial assays employing Saccharomyces and E. coli indicator organsims. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #21, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 11·3·78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

David Brusick 11/6/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

V. RESULTS

TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RU#21
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 19, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 15 | | 19 | |
| POSITIVE CONTROL** | --- | --- | 401 | | 613 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 13 | | 16 | |
| 0.010000 UL | --- | --- | 14 | | 23 | |
| 0.100000 UL | --- | --- | 12 | | 21 | |
| 1.000000 UL | --- | --- | 11 | | 20 | |
| 5.000000 UL | --- | --- | 11 | | 21 | |
| 10.000000 UL | --- | --- | 9 | | 26 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 15 | | 57 | |
| POSITIVE CONTROL*** | RAT | LIVER | 426 | | 73+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 6 | | 42 | |
| 0.010000 UL | RAT | LIVER | 9 | | 43 | |
| 0.100000 UL | RAT | LIVER | 15 | | 48 | |
| 1.000000 UL | RAT | LIVER | 15 | | 48 | |
| 5.000000 UL | RAT | LIVER | 14 | | 38 | |
| 10.000000 UL | RAT | LIVER | 13 | | 73 | |

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* TRY+ CONVERTANTS PER PLATE

| | | | | | |
|---|---|---|---|---|---|
| **$WP_2uvrA^-$ | 2-NITROFLUORENE | 10 UG/PLATE | ***$WP_2uvrA^-$ | 2-(2FURYL)-3-(5-NITRO-2FURYL)-ACRYLAMIDE | 2.5 UG/PLATE |
| D4 | N-METHYL,N-NITRO,N-NITROSOGUANIDINE | 10 UG/PLATE | D4 | 2-ANTHRAMINE | 2.5 UG/PLATE |

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. **SPONSOR:** Westinghouse

II. **MATERIAL***

A. **Identification:** RO #22

B. **Date Received:** October 6, 1978

C. **Physical Description:** Brown liquid with particles

III. **TYPE OF ASSAY:** Plate Incorporation Assay

IV. **PROTOCOL NO.:** DMT-100

V. **RESULTS**

The results of this assay are presented in Table 1.

VI. **INTERPRETATION OF RESULTS AND CONCLUSIONS**

The test compound was examined for mutagenic activity in a series of in vitro microbial assays employing Saccharomyces and E. coli indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative. D4 was repeated because of the slightly higher counts observed at the lower three doses when compared to the higher three dose levels. The repeat test was also negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative. D4 was repeated because of the inconsistent counts observed over all dose levels. The repeat test was also negative.

---

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #22, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 11·13·78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

David Brusick 11/13/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

TABLE I

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#22
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 31, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | WP2uvrA⁻ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | |
| SOLVENT CONTROL | --- | --- | 15 | | 19 | 43 |
| POSITIVE CONTROL** | --- | --- | 401 | | 613 | 576 |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 11 | | 27 | 43 |
| 0.010000 UL | --- | --- | 10 | | 23 | 40 |
| 0.100000 UL | --- | --- | 6 | | 32 | 36 |
| 1.000000 UL | --- | --- | 2 | | 18 | 40 |
| 5.000000 UL | --- | --- | 7 | | 21 | 47 |
| 10.000000 UL | --- | --- | 4 | | 23 | 42 |
| ACTIVATION | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 15 | | 63 | 57 |
| POSITIVE CONTROL*** | RAT | LIVER | 426 | | 73+ | 46 |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 22 | | 23 | 38 |
| 0.010000 UL | RAT | LIVER | 15 | | 52 | 38 |
| 0.100000 UL | RAT | LIVER | 23 | | 26 | 51 |
| 1.000000 UL | RAT | LIVER | 11 | | 51 | 65 |
| 5.000000 UL | RAT | LIVER | 8 | | 27 | 52 |
| 10.000000 UL | RAT | LIVER | 9 | | 55 | 52 |

* TRY+ CONVERTANTS PER PLATE

** WP2uvrA⁻ 2-NITROFLUORENE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

*** WP2uvrA⁻ 2-(2 Furyl)-3-(5-Nitro-2furyl)-Acrylamide 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #23

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid with particles

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: SPECIAL

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organsims. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

---

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #23, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 11·3·78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

1/6/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

V. RESULTS

TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RU#23
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 19, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE<br>$WP_2uvrA^-$<br>1 | <br><br>2 | <br>D4*<br>1 | <br><br>2 |
|---|---|---|---|---|---|---|
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 15 | | 19 | |
| POSITIVE CONTROL** | --- | --- | 401 | | 613 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 5 | | 24 | |
| 0.010000 UL | --- | --- | 8 | | 19 | |
| 0.100000 UL | --- | --- | 11 | | 24 | |
| 1.000000 UL | --- | --- | 8 | | 21 | |
| 5.000000 UL | --- | --- | 10 | | 16 | |
| 10.000000 UL | --- | --- | 12 | | 26 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 15 | | 63 | |
| POSITIVE CONTROL*** | RAT | LIVER | 426 | | 73+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 16 | | 51 | |
| 0.010000 UL | RAT | LIVER | 10 | | 70 | |
| 0.100000 UL | RAT | LIVER | 12 | | 67 | |
| 1.000000 UL | RAT | LIVER | 10 | | 51 | |
| 5.000000 UL | RAT | LIVER | 29 | | 56 | |
| 10.000000 UL | RAT | LIVER | 20 | | 67 | |

* TRY+ CONVERTANTS PER PLATE

| | | |
|---|---|---|
| **$WP_2uvrA^-$ | 2-NITROFLUORENE | 10 UG/PLATE |
| D4 | N-METHYL,N-NITRO,N-NITROSOGUANIDINE | 10 UG/PLATE |
| ***$WP_2uvrA^-$ | 2-(2FURYL)-3-(5-NITRO-2FURYL)-ACRYLAMIDE | 2.5 UG/PLATE |
| D4 | 2-ANTHRAMINE | 2.5 UG/PLATE |

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #24

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid with particles

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: SPECIAL

## V. RESULTS

The results of this assay are presented in Table 1.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The test compound exhibited slight toxicity with the strain $WP_2uvrA^-$ at 10 µl and with D4 at 0.1, 1.0, 5 and 10 µl per plate dose levels in activation.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #24, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 11.3.78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

David Brusick 11/6/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

## TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: KO#24
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 19, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|---|
| | | | | $WP_2uvrA^-$ | | D4* | |
| | | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | | |
| SOLVENT CONTROL | | --- | --- | 15 | | 19 | |
| POSITIVE CONTROL** | | --- | --- | 401 | | 613 | |
| TEST COMPOUND | | | | | | | |
| | 0.005000 UL | --- | --- | 8 | | 17 | |
| | 0.010000 UL | --- | --- | 10 | | 27 | |
| | 0.100000 UL | --- | --- | 11 | | 29 | |
| | 1.000000 UL | --- | --- | 7 | | 24 | |
| | 5.000000 UL | --- | --- | 4 | | 21 | |
| | 10.000000 UL | --- | --- | 1 | | 27 | |
| ACTIVATION | | | | | | | |
| SOLVENT CONTROL | | RAT | LIVER | 15 | | 63 | |
| POSITIVE CONTROL*** | | RAT | LIVER | 426 | | 73+ | |
| TEST COMPOUND | | | | | | | |
| | 0.005000 UL | RAT | LIVER | 20 | | 69 | |
| | 0.010000 UL | RAT | LIVER | 14 | | 54 | |
| | 0.100000 UL | RAT | LIVER | 21 | | 22 | |
| | 1.000000 UL | RAT | LIVER | 16 | | 29 | |
| | 5.000000 UL | RAT | LIVER | 14 | | 22 | |
| | 10.000000 UL | RAT | LIVER | 17 | | 26 | |

* TRY+ CONVERTANTS PER PLATE

| | | | | | |
|---|---|---|---|---|---|
| **$WP_2uvrA^-$ | 2-NITROFLUORENE | 10 UG/PLATE | ***$WP_2uvrA^-$ | 2-(2FURYL)-3-(5-NITRO-2FURYL)-ACRYLAMIDE | 2.5 UG/PLATE |
| D4 | N-METHYL,N-NITRO,N-NITROSOGUANIDINE | 10 UG/PLATE | D4 | 2-ANTHRAMINE | 2.5 UG/PLATE |

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #25

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid with particles

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: SPECIAL

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organsims. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

---

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #25, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath
D.R. Jagannath, Ph.D.
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

11·3·78
Date

Reviewed by:

David J. Brusick, Ph.D.
Director
Department of Genetics
and Cell Biology

11/6/78
Date

V. RESULTS

## TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#25
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 19, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|---|
| | | | | $WP_2uvrA^-$ | | D4* | |
| | | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | | |
| SOLVENT CONTROL | | --- | --- | 15 | | 19 | |
| POSITIVE CONTROL** | | --- | --- | 401 | | 613 | |
| TEST COMPOUND | | | | | | | |
| | 0.005000 UL | --- | --- | 8 | | 25 | |
| | 0.010000 UL | --- | --- | 7 | | 21 | |
| | 0.100000 UL | --- | --- | 4 | | 25 | |
| | 1.000000 UL | --- | --- | 11 | | 21 | |
| | 5.000000 UL | --- | --- | 14 | | 24 | |
| | 10.000000 UL | --- | --- | 8 | | 17 | |
| ACTIVATION | | | | | | | |
| SOLVENT CONTROL | | RAT | LIVER | 15 | | 63 | |
| POSITIVE CONTROL*** | | RAT | LIVER | 426 | | 73+ | |
| TEST COMPOUND | | | | | | | |
| | 0.005000 UL | RAT | LIVER | 10 | | 54 | |
| | 0.010000 UL | RAT | LIVER | 19 | | 57 | |
| | 0.100000 UL | RAT | LIVER | 15 | | 51 | |
| | 1.000000 UL | RAT | LIVER | 13 | | 58 | |
| | 5.000000 UL | RAT | LIVER | 11 | | 67 | |
| | 10.000000 UL | RAT | LIVER | 17 | | 71 | |

---

* TRY+ CONVERTANTS PER PLATE

| | | |
|---|---|---|
| **$WP_2uvrA^-$ | 2-NITROFLUORENE | 10 UG/PLATE |
| D4 | N-METHYL,N-NITRO,N-NITROSOGUANIDINE | 10 UG/PLATE |
| ***$WP_2uvrA^-$ | 2-(2FURYL)-3-(5-NITRO-2FURYL)-ACRYLAMIDE | 2.5 UG/PLATE |
| D4 | 2-ANTHRAMINE | 2.5 UG/PLATE |

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #26

B. Date Received: October 6, 1978

C. Physical Description: Brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #26, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

for Kulbir S. Bakshi 10/27/78
D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

10/30/78
David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

## TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#26
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | |
| SOLVENT CONTROL | --- | --- | 28 | | 14 | |
| POSITIVE CONTROL** | --- | --- | 517 | | 60 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 15 | | 10 | |
| 0.010000 UL | --- | --- | 9 | | 17 | |
| 0.100000 UL | --- | --- | 19 | | 17 | |
| 1.000000 UL | --- | --- | 11 | | 17 | |
| 5.000000 UL | --- | --- | 24 | | 11 | |
| 10.000000 UL | --- | --- | 20 | | 13 | |
| ACTIVATION | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 31 | | 18 | |
| POSITIVE CONTROL*** | RAT | LIVER | 55 | | 29+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 15 | | 15 | |
| 0.010000 UL | RAT | LIVER | 18 | | 12 | |
| 0.100000 UL | RAT | LIVER | 23 | | 11 | |
| 1.000000 UL | RAT | LIVER | 25 | | 21 | |
| 5.000000 UL | RAT | LIVER | 21 | | 25 | |
| 10.000000 UL | RAT | LIVER | 25 | | 10 | |

* TRY+ CONVERTANTS PER PLATE

**$WP_2uvrA^-$ N-METHYL, N-NITRU, N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL, N-NITRO, N-NITROSOGUANIDINE 10 UG/PLATE

***$WP_2uvrA$- 2-(2 FURYL)-3-(5-NITRO-2-FURYL) ACRYLAMIDE 2,5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

# MUTAGENICITY EVALUATION OF

# RO #3-1to9

# IN THE
# PLATE INCORPORATION ASSAY

## FINAL REPORT

SUBMITTED TO:

WESTINGHOUSE ELECTRIC CORPORATION
BEULAH ROAD
PITTSBURGH, PENNSYLVANIA 15235

SUBMITTED BY:

LITTON BIONETICS, INC.
5516 NICHOLSON LANE
KENSINGTON, MARYLAND 20795

LBI PROJECT NO. 20988

OCTOBER 1978

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #3-1

B. Date Received: September 12, 1978

C. Physical Description: Colorless liquid with white particles

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of in vitro microbial assays employing Saccharomyces and E. coli indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #3-1, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

for D.R. Jagannath, Ph.D.
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

10/27/78
Date

Reviewed by:

David Brusick

David J. Brusick, Ph.D.
Director
Department of Genetics
and Cell Biology

10/30/78
Date

V. RESULTS

TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#3-1
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 19 | | 11 | |
| POSITIVE CONTROL** | --- | --- | 765 | | 200 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 15 | | 9 | |
| 0.010000 UL | --- | --- | 13 | | 6 | |
| 0.100000 UL | --- | --- | 13 | | 15 | |
| 1.000000 UL | --- | --- | 10 | | 13 | |
| 5.000000 UL | --- | --- | 12 | | 12 | |
| 10.000000 UL | --- | --- | 10 | | 15 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 13 | | 18 | |
| POSITIVE CONTROL*** | RAT | LIVER | 59 | | 44+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 16 | | 15 | |
| 0.010000 UL | RAT | LIVER | 13 | | 19 | |
| 0.100000 UL | RAT | LIVER | 16 | | 8 | |
| 1.000000 UL | RAT | LIVER | 13 | | 8 | |
| 5.000000 UL | RAT | LIVER | 14 | | 24 | |
| 10.000000 UL | RAT | LIVER | 16 | | 7 | |

* TRY+ CONVERTANTS PER PLATE

| | | | |
|---|---|---|---|
| **$WP_2uvrA^-$ | N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE | ***$WP_2uvrA^-$ | 2-(2 FURYL)-3-(5-NITRO-2 FURYL)-ACRYLAMIDE 2.5 UG/PLATE |
| D4 | N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE | D4 | 2-ANTHRAMINE 2.5 UG/PLATE |

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #3-2

B. Date Received: September 12, 1978

C. Physical Description: Pale yellow liquid with suspended particles

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of in vitro microbial assays employing Saccharomyces and E. coli indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

Slight toxicity was observed at 10 µl per plate with the strain $WP_2uvrA^-$.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #3-2, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

**Submitted by:**

**Study Director**

for
D.R. Jagannath, Ph.D. — 10/27/78 Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

**Reviewed by:**

David J. Brusick, Ph.D. — 10/30/78 Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

TABLE I

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#3-2
B. SOLVENT: P-DIOXANE
C. TEST INITIATION DATE: OCT. 17, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | |
| SOLVENT CONTROL | --- | --- | 19 | | 11 | |
| POSITIVE CONTROL** | --- | --- | 765 | | 200 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 17 | | 10 | |
| 0.010000 UL | --- | --- | 8 | | 17 | |
| 0.100000 UL | --- | --- | 11 | | 11 | |
| 1.000000 UL | --- | --- | 19 | | 6 | |
| 5.000000 UL | --- | --- | 18 | | 10 | |
| 10.000000 UL | --- | --- | 7 | | 10 | |
| ACTIVATION | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 27 | | 18 | |
| POSITIVE CONTROL*** | RAT | LIVER | 59 | | 44+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 16 | | 13 | |
| 0.010000 UL | RAT | LIVER | 15 | | 13 | |
| 0.100000 UL | RAT | LIVER | 25 | | 15 | |
| 1.000000 UL | RAT | LIVER | 18 | | 11 | |
| 5.000000 UL | RAT | LIVER | 37 | | 18 | |
| 10.000000 UL | RAT | LIVER | 27 | | 17 | |

---

* TRY+ CONVERTANTS PER PLATE

**$WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

***$WP_2uvrA$- 2-(2 FURYL)-3-(5-NITRO-2 FURYL)-ACRYLAMIDE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse Electric Corporation

II. MATERIAL*

A. Identification: RO #3-3

B. Date Received: September 12, 1978

C. Physical Description: Rust liquid

III. TYPE OF ASSAY: Plate Incorporation Assays

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of _in vitro_ microbial assays employing _Saccharomyces_ and _E. coli_ indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats. The following results were obtained:

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.001 µl to 10 µl per plate.

The results of the test conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound RO #3-3 did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D R Jagannath 10·20·78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

10/20/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#3-3
B. SOLVENT: ACETONE
C. TEST INITIATION DATE: OCT. 2, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| NONACTIVATION | | | | | | |
| SOLVENT CONTROL | --- | --- | 17 | | 35 | |
| POSITIVE CONTROL** | --- | --- | 518 | | 533 | |
| TEST COMPOUND | | | | | | |
| 0.001000 UL | --- | --- | 14 | | 20 | |
| 0.010000 UL | --- | --- | 13 | | 40 | |
| 0.100000 UL | --- | --- | 10 | | 20 | |
| 1.000000 UL | --- | --- | 12 | | 28 | |
| 5.000000 UL | --- | --- | 8 | | 31 | |
| 10.000000 UL | --- | --- | 16 | | 19 | |
| ACTIVATION | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 13 | | 31 | |
| POSITIVE CONTROL*** | RAT | LIVER | 21 | | 32+ | |
| TEST COMPOUND | | | | | | |
| 0.001000 UL | RAT | LIVER | 10 | | 29 | |
| 0.010000 UL | RAT | LIVER | 6 | | 30 | |
| 0.100000 UL | RAT | LIVER | 18 | | 30 | |
| 1.000000 UL | RAT | LIVER | 8 | | 30 | |
| 5.000000 UL | RAT | LIVER | 11 | | 25 | |
| 10.000000 UL | RAT | LIVER | 25 | | 31 | |

* TRY+ CONVERTANTS PER PLATE

** $WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

*** $WP_2uvrA^-$ 2-(2-FURYL)-3-(5-NITRO-2FURYL)-ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse Electric Corporation

II. MATERIAL*

A. Identification: RO #3-4

B. Date Received: September 12, 1978

C. Physical Description: Orange liquid

III. TYPE OF ASSAY: Plate Incorporation Assays

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Salmonella* and *Saccharomyces* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effects at the high dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.001 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

---

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound RO #3-4 did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 10.20.78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

10/20/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

### TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: KO#3-4
B. SOLVENT: ACETONE
C. TEST INITIATION DATE: OCT. 2, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE |  |  |  |
|---|---|---|---|---|---|---|
|  |  |  | WP$_2$uvrA$^-$ |  | D4* |  |
|  |  |  | 1 | 2 | 1 | 2 |
| **NONACTIVATION** |  |  |  |  |  |  |
| SOLVENT CONTROL | --- | --- | 17 |  | 35 |  |
| POSITIVE CONTROL** | --- | --- | 518 |  | 533 |  |
| TEST COMPOUND |  |  |  |  |  |  |
| 0.001000 UL | --- | --- | 10 |  | 28 |  |
| 0.010000 UL | --- | --- | 9 |  | 33 |  |
| 0.100000 UL | --- | --- | 11 |  | 32 |  |
| 1.000000 UL | --- | --- | 11 |  | 29 |  |
| 5.000000 UL | --- | --- | 17 |  | 24 |  |
| 10.000000 UL | --- | --- | 12 |  | 28 |  |
| **ACTIVATION** |  |  |  |  |  |  |
| SOLVENT CONTROL | RAT | LIVER | 13 |  | 31 |  |
| POSITIVE CONTROL*** | RAT | LIVER | 21 |  | 32+ |  |
| TEST COMPOUND |  |  |  |  |  |  |
| 0.001000 UL | RAT | LIVER | 9 |  | 29 |  |
| 0.010000 UL | RAT | LIVER | 8 |  | 22 |  |
| 0.100000 UL | RAT | LIVER | 11 |  | 29 |  |
| 1.000000 UL | RAT | LIVER | 9 |  | 38 |  |
| 5.000000 UL | RAT | LIVER | 13 |  | 31 |  |
| 10.000000 UL | RAT | LIVER | 15 |  | 30 |  |

---

* TRY+ CONVERTANTS PER PLATE

** WP$_2$uvrA$^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

*** WP$_2$uvrA$^-$ 2-(2 FURYL)-3-(5-NITRO-2 FURYL)-ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

I. SPONSOR: Westinghouse Electric Corporation

II. MATERIAL*

A. Identification: RO #3-5

B. Date Received: September 12, 1978

C. Physical Description: Dark Brown Liquid

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of _in vitro_ microbial assays employing _Saccharomyces_ and _E. coli_ indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats. The following results were obtained:

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.001 µl to 10 µl per plate.

The results of the test conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound RO #3-5 did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D.R. Jagannath 10.20.78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

10/23/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

### TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#3-5
B. SOLVENT: ACETONE
C. TEST INITIATION DATE: OCT. 2, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICRULITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 17 | | 35 | |
| POSITIVE CONTROL** | --- | --- | 518 | | 533 | |
| TEST COMPOUND | | | | | | |
| 0.001000 UL | --- | --- | 17 | | 24 | |
| 0.010000 UL | --- | --- | 12 | | 34 | |
| 0.100000 UL | --- | --- | 15 | | 35 | |
| 1.000000 UL | --- | --- | 10 | | 31 | |
| 5.000000 UL | --- | --- | 12 | | 19 | |
| 10.000000 UL | --- | --- | 9 | | 19 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 13 | | 31 | |
| POSITIVE CONTROL*** | RAT | LIVER | 21 | | 32+ | |
| TEST COMPOUND | | | | | | |
| 0.001000 UL | RAT | LIVER | 9 | | 20 | |
| 0.010000 UL | RAT | LIVER | 19 | | 27 | |
| 0.100000 UL | RAT | LIVER | 12 | | 28 | |
| 1.000000 UL | RAT | LIVER | 13 | | 25 | |
| 5.000000 UL | RAT | LIVER | 13 | | 31 | |
| 10.000000 UL | RAT | LIVER | 13 | | 31 | |

* TRY+ CONVERTANTS PER PLATE

** $WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

*** $WP_2uvrA^-$ 2-(2 FURYL)-3-(5-NITRO-2 FURYL)-ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

I. SPONSOR: Westinghouse Electric Corporation

II. MATERIAL*

A. Identification: RO #3-6

B. Date Received: September 12, 1978

C. Physical Description: Brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assays

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of in vitro microbial assays employing Saccharomyces and E. coli indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effects at the high dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.001 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound RO #3-6 did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

D R Jagannath 10·20·78

D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

10/20/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

## TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#3-6
B. SOLVENT: ACETONE
C. TEST INITIATION DATE: OCT. 2, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 17 | | 35 | |
| POSITIVE CONTROL** | --- | --- | 518 | | 533 | |
| TEST COMPOUND | | | | | | |
| 0.001000 UL | --- | --- | 20 | | 32 | |
| 0.010000 UL | --- | --- | 14 | | 31 | |
| 0.100000 UL | --- | --- | 6 | | 28 | |
| 1.000000 UL | --- | --- | 10 | | 26 | |
| 5.000000 UL | --- | --- | 13 | | 38 | |
| 10.000000 UL | --- | --- | 9 | | 27 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 13 | | 31 | |
| POSITIVE CONTROL*** | RAT | LIVER | 21 | | 32+ | |
| TEST COMPOUND | | | | | | |
| 0.001000 UL | RAT | LIVER | 9 | | 26 | |
| 0.010000 UL | RAT | LIVER | 13 | | 21 | |
| 0.100000 UL | RAT | LIVER | 15 | | 25 | |
| 1.000000 UL | RAT | LIVER | 10 | | 22 | |
| 5.000000 UL | RAT | LIVER | 18 | | 36 | |
| 10.000000 UL | RAT | LIVER | 11 | | 21 | |

* TRY+ CONVERTANTS PER PLATE

** $WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

*** $WP_2uvrA^-$ 2-(2 FURYL) -3-(5-NITRO-2-FURYL) ACRYLAMIDE 2.5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #3-7

B. Date Received: September 12, 1978

C. Physical Description: Dark brown suspension

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

## V. RESULTS

The results of this assay are presented in Table 1.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative. $WP_2uvrA^-$ was repeated because of contamination at the 0.1 µl dose level. The repeat test was also negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative. $WP_2uvrA^-$ was repeated at the 0.1 µl dose level because of contamination. The repeat test was also negative.

---

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #3-7, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

for Kulbir S. Bakshi 10/27/78
D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

David Brusick 10/30/78
David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

## TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#3-7
B. SOLVENT: ACETONE
C. TEST INITIATION DATE: OCT. 2, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 17 | 13 | 35 | |
| POSITIVE CONTROL** | --- | --- | 518 | 765 | 533 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 12 | 16 | 20 | |
| 0.010000 UL | --- | --- | 6 | 14 | 31 | |
| 0.100000 UL | --- | --- | C | 13 | 30 | |
| 1.000000 UL | --- | --- | 11 | 16 | 27 | |
| 5.000000 UL | --- | --- | 10 | 18 | 28 | |
| 10.000000 UL | --- | --- | 14 | 16 | 24 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 13 | 21 | 31 | |
| POSITIVE CONTROL*** | RAT | LIVER | 21 | 59 | 32+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 13 | 18 | 26 | |
| 0.010000 UL | RAT | LIVER | 11 | 27 | 31 | |
| 0.100000 UL | RAT | LIVER | C | 31 | 25 | |
| 1.000000 UL | RAT | LIVER | 18 | 23 | 32 | |
| 5.000000 UL | RAT | LIVER | 17 | 29 | 25 | |
| 10.000000 UL | RAT | LIVER | 9 | 20 | 28 | |

---

* TRY+ CONVERTANTS PER PLATE

| | | |
|---|---|---|
| **$WP_2uvrA^-$ | N-METHYL,N-NITRO,N-NITROSOGUANIDINE | 10 UG/PLATE |
| D4 | N-METHYL,N-NITRO,N-NITROSOGUANIDINE | 10 UG/PLATE |
| ***$WP_2uvrA$- | 2-(2 FURYL)-3-(5-NITRO-2 FURYL)-ACRYLAMIDE | 2,5 UG/PLATE |
| D4 | 2-ANTHRAMINE | 2.5 UG/PLATE |

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

C = CONTAMINATION

I. **SPONSOR:** Westinghouse

II. **MATERIAL***

A. Identification: RO #3-8

B. Date Received: September 12, 1978

C. Physical Description: Dark brown liquid

III. **TYPE OF ASSAY:** Plate Incorporation Assay

IV. **PROTOCOL NO.:** Special

## V. RESULTS

The results of this assay are presented in Table 1.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #3-8, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

Submitted by:

Study Director

10/27/78

for D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

Reviewed by:

10/27/78

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

## TABLE I

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: RO#3-8
B. SOLVENT: ACETONE
C. TEST INITIATION DATE: OCT. 2, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 17 | | 35 | |
| POSITIVE CONTROL** | --- | --- | 518 | | 533 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 16 | | 21 | |
| 0.010000 UL | --- | --- | 15 | | 22 | |
| 0.100000 UL | --- | --- | 21 | | 28 | |
| 1.000000 UL | --- | --- | 14 | | 39 | |
| 5.000000 UL | --- | --- | 14 | | 24 | |
| 10.000000 UL | --- | --- | 16 | | 29 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 13 | | 31 | |
| POSITIVE CONTROL*** | RAT | LIVER | 21 | | 32+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 11 | | 22 | |
| 0.010000 UL | RAT | LIVER | 13 | | 39 | |
| 0.100000 UL | RAT | LIVER | 10 | | 18 | |
| 1.000000 UL | RAT | LIVER | 13 | | 10 | |
| 5.000000 UL | RAT | LIVER | 12 | | 15 | |
| 10.000000 UL | RAT | LIVER | 12 | | 23 | |

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* TRY+ CONVERTANTS PER PLATE

** $WP_2uvrA^-$ N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE
D4 N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE

***$WP_2uvrA$- 2-(2 FURYL)-3-(5-NITRO-2FURYL) ACRYLAMIDE 2,5 UG/PLATE
D4 2-ANTHRAMINE 2.5 UG/PLATE

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

I. SPONSOR: Westinghouse

II. MATERIAL*

A. Identification: RO #3-9

B. Date Received: September 12, 1978

C. Physical Description: Dark brown liquid

III. TYPE OF ASSAY: Plate Incorporation Assay

IV. PROTOCOL NO.: Special

V. RESULTS

The results of this assay are presented in Table 1.

VI. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Saccharomyces* and *E. coli* indicator organisms. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats.

The compound was tested over a series of concentrations such that there was either quantitative or qualitative evidence of some chemically-induced physiological effect at the highest dose level. The low dose in all cases was below a concentration that demonstrated any toxic effect. The dose range employed for the evaluation of this compound was from 0.005 µl to 10 µl per plate.

The results of the tests conducted on the compound in the absence of a metabolic activation system were all negative. A repeat test was conducted with $WP_2uvrA^-$ because of the very low count at 0.1 µl dose level. The repeat test was also negative.

The results of the tests conducted on the compound in the presence of a rat liver activation system were all negative.

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*Information was supplied by the sponsor. If the sponsor did not indicate this information, N.I. was entered.

## VI. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

The test compound, RO #3-9, did not demonstrate genetic activity in any of the assays conducted in this evaluation and was considered not mutagenic under these test conditions.

**Submitted by:**

**Study Director**

Kulbir S Bakshi 10/27/78
for D.R. Jagannath, Ph.D. Date
Section Chief
Submammalian Genetics
Department of Genetics
and Cell Biology

**Reviewed by:**

David Brusick 10/30/78
David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

## V. RESULTS

## TABLE 1

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: KO#3-9
B. SOLVENT: ACETONE
C. TEST INITIATION DATE: OCT. 2, 1978
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) PER PLATE.

| TEST | SPECIES | TISSUE | REVERTANTS PER PLATE | | | |
|---|---|---|---|---|---|---|
| | | | $WP_2uvrA^-$ | | D4* | |
| | | | 1 | 2 | 1 | 2 |
| **NONACTIVATION** | | | | | | |
| SOLVENT CONTROL | --- | --- | 16 | 13 | 35 | |
| POSITIVE CONTROL** | --- | --- | 518 | 765 | 533 | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | --- | --- | 13 | 10 | 33 | |
| 0.010000 UL | --- | --- | 9 | 17 | 25 | |
| 0.100000 UL | --- | --- | 4 | 18 | 24 | |
| 1.000000 UL | --- | --- | 9 | 9 | 29 | |
| 5.000000 UL | --- | --- | 17 | 10 | 29 | |
| 10.000000 UL | --- | --- | 10 | 14 | 22 | |
| **ACTIVATION** | | | | | | |
| SOLVENT CONTROL | RAT | LIVER | 13 | | 31 | |
| POSITIVE CONTROL*** | RAT | LIVER | 21 | | 32+ | |
| TEST COMPOUND | | | | | | |
| 0.005000 UL | RAT | LIVER | 15 | | 32 | |
| 0.010000 UL | RAT | LIVER | 16 | | 35 | |
| 0.100000 UL | RAT | LIVER | 17 | | 31 | |
| 1.000000 UL | RAT | LIVER | 5 | | 29 | |
| 5.000000 UL | RAT | LIVER | 16 | | 31 | |
| 10.000000 UL | RAT | LIVER | 9 | | 27 | |

* TRY+ CONVERTANTS PER PLATE

| | | | |
|---|---|---|---|
| ** $WP_2uvrA^-$ | N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE | *** $WP_2uvrA^-$ | 2-(2 FURYL)-3-(5-NITRO-2 FURYL)-ACRYLAMIDE 2.5 UG/PLATE |
| D4 | N-METHYL,N-NITRO,N-NITROSOGUANIDINE 10 UG/PLATE | D4 | 2-ANTHRAMINE 2.5 UG/PLATE |

+ THERE IS NO KNOWN POSITIVE CONTROL COMPOUND THAT WORKS CONSISTENTLY WITH THIS STRAIN IN THE ACTIVATION PLATE ASSAYS.

## APPENDIX B

## BIOASSAY DATA FROM STANFORD RESEARCH INSTITUTE INTERNATIONAL, INC.

This Appendix contains all the reports submitted by SRI International, Inc., as part of their subcontract. To save space and cost, the test methods have been removed and are reproduced only once in Section 5, Experimental Techniques.

These reports cover the Ames *Salmonella*/microsome assay of residual oil samples RO#1 to RO#26, nine fractions of RO#3, and seven chromatography fractions of RO#1, RO#5, RO#12, RO#14, RO#15, and RO#16.

SRI International

# IN VITRO MICROBIOLOGICAL MUTAGENICITY ASSAYS OF FOUR WESTINGHOUSE ELECTRIC CORPORATION SAMPLES

Final Report

4 October 1978

By: Vincent F. Simmon, Ph.D., Manager
Microbial Genetics Program
Gregory F. Shepherd, Microbiologist

Prepared for:

WESTINGHOUSE ELECTRIC CORPORATION
Westinghouse Research Laboratory
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Attention: Dr. Andris Zerwins
Technical Monitor

SRI Project LSC-7044
Subcontract No. EPA 68-02-2638

Approved by:

David C. L. Jones

David C. L. Jones, Director
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# SUMMARY

SRI International examined Westinghouse samples $RO_1$, $RO_2$, $RO_3$, and $RO_4$ for mutagenic activity with strains TA1535, TA1537, TA1538, TA98, and TA100 of the bacterium *Salmonella typhimurium* in the Ames *Salmonella*/microsome assay. Each assay was performed both in the presence and in the absence of a metabolic activation system. All the samples appeared to be frameshift mutagens in the presence of metabolic activation.

# INTRODUCTION

SRI International examined Westinghouse samples $RO_1$, $RO_2$, $RO_3$, and $RO_4$ for mutagenic activity by in vitro microbiological assays with five strains of *Salmonella typhimurium* (TA1535, TA1537, TA1538, TA98, and TA100). An Aroclor 1254-stimulated, rat liver homogenate metabolic activation system was included in the assay procedure to provide steps that the bacteria either are incapable of conducting or do not carry out under the assay conditions.

The Ames *Salmonella*/microsome asssay procedure has proven to be 80 to 90% reliable in detecting mutagens and it has about the same reliability in identifying chemicals that are not carcinogenic.[1] However, because this test system does not always provide 100% correlation with animal carcinogenicity investigations, neither a positive nor a negative response proves conclusively that a chemical is hazardous or nonhazardous to man.

## RESULTS AND DISCUSSION

Tables 1 through 7 present the results of the microbiological assays conducted on Westinghouse samples $RO_1$, $RO_2$, $RO_3$, and $RO_4$. The samples were tested over a wide range of concentrations, from 10 to 5000 µg/plate. Samples $RO_1$, $RO_2$, and $RO_3$ were tested using two different plate incubation times, 48 hours and 64 hours. Sample $RO_4$ was incubated for 64 hours in both assays; therefore, the data presented in Table 7 are an average of two experiments conducted on separate days.

Tables 1 and 2 present the data from the testing of sample $RO_1$. In both the 48-hour test (Table 1) and the 64-hour test (Table 2), $RO_1$ caused a dose-related increase in the number of histidine-independent revertants in *Salmonella* strains TA1537, TA1538, TA98, and TA100 in the presence of metabolic activation. Slight dose-related elevations were also observed in both tests in *Salmonella* strains TA1537, TA1538, and TA98 without metabolic activation. At the dose of 5000 µg/plate, sample $RO_1$ appeared to be toxic to strains TA1538 and TA100 without metabolic activation.

Westinghouse sample $RO_2$ was mutagenic, with dose-related increases observed in the number of histidine-independent revertants in strains TA1538, TA98, and TA100 in the presence of metabolic activation. In the 48-hour test (Table 3), a slight increase in histidine-independent revertants was observed in strain TA1537 without metabolic activation. This was also observed in the 64-hour test (Table 4), both in the presence and in the absence of metabolic activation.

In both the 48-hour test (Table 5) and the 64-hour test (Table 6), $RO_3$ was found to be mutagenic in the presence of metabolic activation in *S. typhimurium* strains TA1538, TA98, and TA100. Slightly elevated numbers were obtained in the 64-hour test in strain TA1535 without metabolic activation and TA1537 with metabolic activation. Toxicity was observed on strain TA100 at 5000 µg/plate with and without metabolic activation.

Table 7 presents the averaged data from two tests conducted on sample $RO_4$. $RO_4$ caused a weak but reproducible dose-related increase in the number of histidine-independent revertants in strains TA1538, TA98, and TA100 in the presence of metabolic activation.

In summary, samples $RO_1$, $RO_2$, $RO_3$, and $RO_4$ were found to be frameshift mutagens having various potencies in affecting *S. typhimurium* strains TA1537, TA1538, TA98, and TA100, primarily in the presence of metabolic activation. Some elevated responses were also observed in various strains in assays conducted without metabolic activation.

Table 1

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

$RO_1$

48-Hour Incubation

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative Control | - | 50,000 | 19 | 5 | 20 | 26 | 95 |
| (Dioxane) | + | 50,000 | 10 | 10 | 25 | 29 | 116 |
| Positive Control | | | | | | | |
| Sodium azide | - | 0.5 | 218 | | | | 345 |
| 9-Aminoacridine | - | 50 | | 463 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 955 | 672 | |
| 2-Anthramine | - | 2.5 | 8 | 3 | | | |
| | + | 2.5 | 174 | 88 | | | |
| | - | 1.0 | | | 12 | 17 | 80 |
| | + | 1.0 | | | 304 | 237 | 372 |
| $RO_1$ | - | 10 | 9 | 6 | 18 | 18 | 82 |
| | - | 50 | 17 | 8 | 13 | 18 | 95 |
| | - | 100 | 18 | 6 | 9 | 19 | 116 |
| | - | 500 | 21 | 11 | 23 | 28 | 114 |
| | - | 1000 | 19 | 15 | 37 | 31 | 137 |
| | - | 5000 | 16 | 10 | T* | 9 | 12/Tp† |
| | + | 10 | 8 | 8 | 26 | 43 | 185 |
| | + | 50 | 11 | 8 | 31 | 57 | 273 |
| | + | 100 | 11 | 17 | 59 | 74 | 308 |
| | + | 500 | 7 | 24 | 78 | 90 | 405 |
| | + | 1000 | 10 | 10 | 68 | 66 | 451 |
| | + | 5000 | 9 | 16 | 45 | 51 | 72 |

---

* T, toxic.

† p, pinpoint colonies.

## Table 2

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_1$

64-Hour Incubation

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate TA1535 | TA1537 | TA1538 | TA98 | TA100 |
|---|---|---|---|---|---|---|---|
| Negative control | - | 50,000 | 15 | 8 | 12 | 23 | 101 |
| (Dioxane) | + | 50,000 | 15 | 4 | 15 | 24 | 98 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 256 | | | | 379 |
| 9-Aminoacridine | - | 50 | | 104 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1127 | 700 | |
| 2-Anthramine | - | 2.5 | 16 | 17 | | | |
| | + | 2.5 | 129 | 131 | | | |
| | - | 1.0 | | | 20 | 19 | 75 |
| | + | 1.0 | | | 223 | 218 | 370 |
| $RO_1$ | - | 10 | 25 | 13 | 16 | 29 | 83 |
| | - | 50 | 24 | 9 | 15 | 39 | 117 |
| | - | 100 | 16 | 11 | 18 | 49 | 93 |
| | - | 500 | 26 | 17 | 30 | 53 | 106 |
| | - | 1000 | 23 | 18 | 20 | 53 | 125 |
| | - | 5000 | 22 | 8 | 2/T* | 21 | 79 |
| | + | 10 | 12 | 15 | 38 | 54 | 207 |
| | + | 50 | 9 | 21 | 49 | 89 | 291 |
| | + | 100 | 11 | 25 | 52 | 72 | 294 |
| | + | 500 | 13 | 27 | 60 | 123 | 310 |
| | + | 1000 | 14 | 29 | 53 | 94 | 268 |
| | + | 5000 | 10 | 17 | 61 | 48 | 98 |

---

T*, toxic

Table 3

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

$RO_2$

48-Hour Incubation

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate TA1535 | TA1537 | TA1538 | TA98 | TA100 |
|---|---|---|---|---|---|---|---|
| Negative control | - | 50,000 | 19 | 5 | 20 | 26 | 95 |
| (Dioxane) | + | 50,000 | 10 | 10 | 25 | 29 | 116 |
| Positive Controls | | | | | | | |
| Sodium azide | - | 0.5 | 218 | | | | 345 |
| 9-Aminoacridine | - | 50 | | 463 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 955 | 672 | |
| 2-Anthramine | - | 2.5 | 8 | 3 | | | |
| | + | 2.5 | 174 | 88 | | | |
| | - | 1.0 | | | 12 | 17 | 80 |
| | + | 1.0 | | | 304 | 237 | 372 |
| $RO_2$ | - | 10 | 17 | 4 | 14 | 13 | 104 |
| | - | 50 | 13 | 8 | 18 | 27 | 107 |
| | - | 100 | 10 | 6 | 14 | 22 | 81 |
| | - | 500 | 10 | 11 | 19 | 20 | 95 |
| | - | 1000 | 17 | 14 | 20 | 13 | 90 |
| | - | 5000 | 6 | 15 | 19 | 12 | 80 |
| | + | 10 | 10 | 6 | 24 | 44 | 123 |
| | + | 50 | 5 | 5 | 25 | 50 | 210 |
| | + | 100 | 13 | 10 | 42 | 60 | 221 |
| | + | 500 | 10 | 8 | 50 | 75 | 291 |
| | + | 1000 | 7 | 4 | 52 | 62 | 249 |
| | + | 5000 | 9 | 12 | 57 | 63 | 251 |

Table 4

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

$RO_2$

64-Hour Incubation

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control | - | 50,000 | 15 | 8 | 12 | 23 | 101 |
| (Dioxane) | + | 50,000 | 15 | 4 | 15 | 24 | 98 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 256 | | | | 379 |
| 9-Aminoacridine | - | 50 | | 104 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1127 | 1700 | |
| 2-Anthramine | - | 2.5 | 16 | 17 | | | |
| | + | 2.5 | 129 | 131 | | | |
| | - | 1.0 | | | 20 | 19 | 75 |
| | + | 1.0 | | | 223 | 218 | 370 |
| $RO_2$ | - | 10 | 16 | 8 | 11 | 17 | 88 |
| | - | 50 | 25 | 11 | 11 | 38 | 103 |
| | - | 100 | 13 | 9 | 17 | 41 | 123 |
| | - | 500 | 18 | 16 | 12 | 29 | 105 |
| | - | 1000 | 16 | 14 | 9 | 36 | 114 |
| | - | 5000 | 22 | 10 | 11 | 16 | 88 |
| | + | 10 | 10 | 7 | 22 | 38 | 168 |
| | + | 50 | 13 | 12 | 31 | 51 | 196 |
| | + | 100 | 12 | 8 | 39 | 58 | 217 |
| | + | 500 | 10 | 12 | 44 | 81 | 238 |
| | + | 1000 | 5 | 13 | 76 | 81 | 258 |
| | + | 5000 | 6 | 13 | 69 | 71 | 154 |

## Table 5

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_3$

## 48-Hour Incubation

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control | - | 50,000 | 19 | 5 | 20 | 26 | 95 |
| (Dioxane) | + | 50,000 | 10 | 10 | 25 | 29 | 116 |
| Positive control | | | | | | | |
| Sodium azide | - | 0.5 | 218 | | | | 345 |
| 9-Aminoacridine | - | 50 | | 463 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 955 | 672 | |
| 2-Anthramine | - | 2.5 | 8 | 3 | | | |
| | + | 2.5 | 174 | 88 | | | |
| | - | 1.0 | | | 12 | 17 | 80 |
| | + | 1.0 | | | 304 | 237 | 372 |
| $RO_3$ | - | 10 | 10 | 2 | 13 | 14 | 86 |
| | - | 50 | 10 | 5 | 12 | 14 | 98 |
| | - | 100 | 12 | 3 | 16 | 18 | 108 |
| | - | 500 | 15 | 7 | 11 | 15 | 88 |
| | - | 1000 | 7 | 7 | 14 | 16 | 68 |
| | - | 5000 | 11 | 3 | 6 | 16 | 48/T* |
| | + | 10 | 10 | 5 | 15 | 30 | 92 |
| | + | 50 | 7 | 3 | 20 | 21 | 138 |
| | + | 100 | 10 | 15 | 25 | 34 | 174 |
| | + | 500 | 10 | 7 | 37 | 44 | 215 |
| | + | 1000 | 6 | 16 | 41 | 54 | 297 |
| | + | 5000 | 4 | 14 | 25 | 22 | 81/T |

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T*, toxic

## Table 6

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_3$

## 64-Hour Incubation

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control | - | 50,000 | 15 | 8 | 12 | 23 | 101 |
| (Dioxane) | + | 50,000 | 15 | 4 | 15 | 24 | 98 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 256 | | | | 379 |
| 9-Aminoacridine | - | 50 | | 104 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1127 | 700 | |
| 2-Anthramine | - | 2.5 | 16 | 17 | | | |
| | + | 2.5 | 129 | 131 | | | |
| | - | 1.0 | | | 20 | 19 | 75 |
| | + | 1.0 | | | 223 | 218 | 370 |
| $RO_3$ | - | 10 | 14 | 8 | 10 | 25 | 123 |
| | - | 50 | 31 | 11 | 11 | 39 | 110 |
| | - | 100 | 32 | 11 | 9 | 29 | 125 |
| | - | 500 | 29 | 15 | 25 | 33 | 99 |
| | - | 1000 | 36 | 8 | 15 | 35 | 119 |
| | - | 5000 | 38 | 8 | 11 | 15 | 90 |
| | + | 10 | 7 | 13 | 27 | 29 | 141 |
| | + | 50 | 10 | 10 | 28 | 64 | 174 |
| | + | 100 | 10 | 20 | 29 | 54 | 190 |
| | + | 500 | 8 | 20 | 47 | 75 | 202 |
| | + | 1000 | 6 | 13 | 54 | 61 | 169 |
| | + | 5000 | 6 | 12 | 43 | 58 | 109 |

# Table 7

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_4$

64-Hour Incubation

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Average Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (Dioxane) | - | 50,000 | 28 | 12 | 23 | 37 | 96 |
| | + | 50,000 | 11 | 11 | 23 | 31 | 108 |
| Positive controls | | | | | | | |
| Sodium Azide | - | 0.5 | 296 | | | | 413 |
| 9-Aminoacridine | - | 50.0 | | 170 | | | |
| 2-Nitrofluorine | - | 50.0 | | | 930 | 627 | |
| 2-Aminoacridine | - | 2.5 | 24 | 15 | | | |
| | + | 2.5 | 102 | 84 | | | |
| | - | 1.0 | | | 18 | 26 | 72 |
| | + | 1.0 | | | 182 | 261 | 367 |
| $RO_4$ | - | 10 | 23 | 12 | 15 | 29 | 114 |
| | - | 50 | 28 | 11 | 13 | 32 | 119 |
| | - | 100 | 23 | 12 | 23 | 32 | 122 |
| | - | 500 | 26 | 13 | 19 | 35 | 109 |
| | - | 1000 | 29 | 10 | 16 | 29 | 97 |
| | - | 5000 | 31 | 8 | 21 | 22 | 89 |
| | + | 10 | 15 | 11 | 25 | 31 | 109 |
| | + | 50 | 16 | 12 | 26 | 38 | 149 |
| | + | 100 | 17 | 10 | 32 | 53 | 155 |
| | + | 500 | 10 | 15 | 37 | 54 | 180 |
| | + | 1000 | 15 | 14 | 39 | 57 | 106 |
| | + | 5000 | 10 | 12 | 42 | 59 | 126 |

SRI International

# IN VITRO MICROBIOLOGICAL MUTAGENICITY ASSAYS OF WESTINGHOUSE ELECTRIC CORPORATION SAMPLES RO$_5$ TO RO$_{26}$

Final Report

December 1978

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# SUMMARY

SRI International examined 22 Westinghouse Electric Corporation samples ($RO_5$ - $RO_{26}$) for mutagenic activity with strains TA1535, TA1537, TA1538, TA98, and TA100 of the bacterium Salmonella typhimurium in the standard Ames Salmonella/microsome assay. Each assay was performed in the presence and in the absence of a rat liver metabolic activation system.

Samples $RO_8$, $RO_{10}$, $RO_{11}$, $RO_{12}$, and $RO_{17}$ were not found to be mutagenic in the Salmonella/microsome assay.

Samples $RO_5$, $RO_9$, $RO_{14}$, $RO_{15}$, $RO_{16}$, $RO_{18}$, $RO_{20}$, $RO_{22}$, $RO_{23}$, $RO_{24}$, $RO_{25}$, and $RO_{26}$ were found to be frameshift mutagens primarily affecting strains TA1537, TA1538, TA98, and TA100.

Samples $RO_6$, $RO_7$, $RO_{13}$, $RO_{19}$, and $RO_{21}$ caused some increases in the number of revertants. However, the increases in revertants caused by these five samples were generally small, not dose-related, and not always reproducible. We conclude that these samples may pose a mutagenic hazard.

None of the samples appeared to be toxic to the bacteria at any dose tested.

# INTRODUCTION

SRI International examined 22 Westinghouse Electric Corporation samples ($RO_5$ - $RO_{26}$) for mutagenic activity using *in vitro* microbiological assays with strains TA1535, TA1537, TA1538, TA98, and TA100 of the bacterium *Salmonella typhimurium* in the standard Ames *Salmonella*/microsome assay. An Aroclor 1254-stimulated, rat liver homogenate metabolic activation system was included in the assay procedures to provide metabolic steps that the bacteria either are incapable of conducting or do not carry out under the assay conditions.

The assay procedure with *S. typhymurium* has proven to be 80 to 90% reliable in detecting carcinogens as mutagens, and it has about the same reliability in identifying chemicals that are not carcinogenic.[1] However, because the test system does not always provide 100% correlation with carcinogenicity investigations in animals, neither a positive nor a negative response conclusively proves that a chemical is hazardous or nonhazardous to man.

## RESULTS AND DISCUSSION

Tables 1 through 57 present the results of the Salmonella/microsome assays conducted on Westinghouse samples $RO_5$ to $RO_{26}$. The samples were tested over a wide range of concentrations, from 10 to 2500 µg/plate. Many of the samples were not miscible with the top agar or formed precipitates when plated (indicated by "*" on the individual tables). This incompatibility with the aqueous test milieu may explain the lack of reproducibility of the results and the irregular responses observed with some of the samples.

### $RO_5$ (Tables 1 and 2)

$RO_5$ was found to cause a reproducible, dose-related increase in the number of histidine-independent revertants in *S. typhimurium* strains TA98 and TA100 in the presence of metabolic activation. In both experiments, $RO_5$ also produced an irregular mutagenic response in strain TA1538 in the presence of metabolic activation.

### $RO_6$ (Tables 3 through 6)

In the first experiment conducted with $RO_6$ (Table 3), a slight elevation over background values was observed in strain TA1538 in the presence of metabolic activation. In the second experiment (Table 4), mutagenic dose-responses were observed in strains TA98 and TA100 in the presence of metabolic activation. To further investigate this effect, two more experiments were performed on two different days (Tables 5 and 6). In both of these experiments, slight increases in strains TA1538 and TA100 in the presence of metabolic activation were observed; mutagenic activity in strain TA98, however, was observed only in the fourth experiment (Table 6) in the presence of metabolic activation. We conclude that $RO_6$ may be mutagenic to strains TA1538, TA98, and TA100.

### $RO_7$ (Tables 7 through 10)

In the first and second assays (Tables 7 and 8), a very slight increase in the number of revertants at higher doses in strains TA98 and TA100 was observed in the presence of metabolic activation. This slight increase occurred again in a third experiment with TA98 (Table 9). However, the increase was not found to be reproducible with either TA98 or TA100. Therefore, we conclude that $RO_7$ may be weakly mutagenic to strain TA98 only in the presence of metabolic activation.

### $RO_8$ (Tables 11 through 13)

Sample $RO_8$ caused very slight elevations in the number of revertants with metabolic activation only with strain TA1538 in the first experiment (Table 11) and only with strain TA100 in the second experiment (Table 12). In a third experiment, no mutagenic activity was observed in either strain. Because sample $RO_8$ failed to demonstrate reproducible mutagenic activity in any of the experiments performed, we conclude this sample is not a mutagen in the Ames assay.

### $RO_9$ (Tables 14 and 15)

Sample $RO_9$ was found to be mutagenic to strains TA1538, TA98, and TA100 in both assays in the presence of metabolic activation. In addition, $RO_9$ caused irregular increases in strain TA1537 in the presence of metabolic activation in both assays. In the second experiment (Table 15), dose-related mutagenicity was observed in strains TA98 and TA100 without metabolic activation.

### $RO_{10}$ (Tables 16 and 17)

In assays performed with sample $RO_{10}$, no reproducible increases were observed in any of the strains. Therefore, we conclude that $RO_{10}$ is not mutagenic in the Ames assay.

$RO_{11}$ (Tables 18 and 19) and $RO_{12}$ (Tables 20 and 21)

No mutagenic activity was observed in any of the assays conducted with samples $RO_{11}$ and $RO_{12}$.

$RO_{13}$ (Tables 22 through 25)

In the first experiment with $RO_{13}$ (Table 22), dose-related increases in revertants were observed in strains TA1538, TA98, and TA100 in the presence of metabolic activation. The increase in revertants with TA1538 and TA100 did not occur in the second experiment but was found to be reproducible in the third and fourth experiments (Tables 24 and 25, respectively). We conclude that sample $RO_{13}$ may be weakly mutagenic to strains TA1538, TA98, and TA100 only in the presence of metabolic activation.

$RO_{14}$ (Tables 26 through 29)

In assays performed with $RO_{14}$, reproducible dose-related increases were observed at the first four to five doses in strains TA98 and TA100 in all tests performed in the presence of metabolic activation. Although the dose-response was slightly irregular, reproducible increases were also observed, at higher doses, in strain TA1538 in the presence of metabolic activation. We conclude that $RO_{14}$ is weakly mutagenic to strains TA1538, TA98, and TA100 with metabolic activation.

$RO_{15}$ (Tables 30 through 33)

$RO_{15}$ was found to be mutagenic to strains TA1538, TA98, and TA100 in the presence of metabolic activation.

$RO_{16}$ (Tables 34 and 35)

$RO_{16}$ was mutagenic to strains TA1537, TA1538, and TA100 in the presence of metabolic activation. Reproducible, dose-related increases in revertants were observed in both experiments in these strains. In the second experiment (Table 35), $RO_{16}$ also produced irregular increases in strains TA1538, TA98, and TA100 without metabolic activation.

### $RO_{17}$ (Tables 36 and 37)

No mutagenic activity was observed in assays conducted with sample $RO_{17}$. Although slight increases were observed in strains TA1538 and TA98 with metabolic activation, the fact that they were neither dose-related nor reproducible led us to conclude that this compound was not mutagenic.

### $RO_{18}$ (Tables 38 and 39)

Sample $RO_{18}$ caused reproducible, dose-related increases in the number of revertants in strains TA1537, TA1538, TA98, and TA100 in the presence of metabolic activation. Slight dose-related increases were also observed in TA98 (Table 38) in the absence of metabolic activation. We conclude that $RO_{18}$ is mutagenic to strains TA1537, TA1538, TA98, and TA100, primarily in the presence of metabolic activation.

### $RO_{19}$ (Tables 40 through 42)

$RO_{19}$ caused irregular, but not always reproducible, increases in strain TA100 in the presence of metabolic activation. This sample may be weakly mutagenic to strain TA100 with activation.

### $RO_{20}$ (Tables 43 and 44)

Sample $RO_{20}$ was mutagenic to strains TA1537, TA1538, and TA98 both in the presence and in the absence of metabolic activation. The sample was less mutagenic to these strains without metabolic activation. $RO_{20}$ was also mutagenic to TA100, but only in the presence of metabolic activation.

### $RO_{21}$ (Tables 45 through 47)

In the assays performed on $RO_{21}$, slight, irregular increases in strains TA1538, TA98, and TA100 were observed when the metabolic activation system was included in the assay. Since these increases were not always reproducible or dose-related, we cannot conclude that sample $RO_{21}$ is mutagenic.

### RO$_{22}$ (Tables 48 and 49)

RO$_{22}$ was mutagenic to strains TA1538, TA98, and TA100 in the presence of metabolic activation.

### RO$_{23}$ (Tables 50 and 51)

In assays conducted with samples RO$_{23}$, mutagenic activity was observed in strains TA1538 and TA98 in the presence of metabolic activation. In the first assay (Table 50), RO$_{23}$ also caused a small dose-related increase in the number of TA100 revertants in the presence of metabolic activation. Slight elevations were again observed in TA100 in the second experiment (Table 51); however, they were not dose-related. We conclude that RO$_{23}$ is mutagenic to strains TA1538 and TA98, and may be mutagenic to strain TA100.

### RO$_{24}$ (Tables 52 and 53)

Mutagenic activity was observed in assays conducted on sample RO$_{24}$ with strains TA1537, TA1538, TA98, and TA100, primarily in the presence of metabolic activation. In the absence of metabolic activation, an irregular elevation in the number of revertants was seen in the same four strains.

### RO$_{25}$ (Tables 54 and 55) and RO$_{26}$ (Tables 56 and 57)

Samples RO$_{25}$ and RO$_{26}$ were found to be mutagens, affecting strains TA1538, TA98, and TA100 only in the presence of metabolic activation.

## Table 1

## *IN VITRO* ASSAYS WITH *SALMONELLA TYPHIMURIUM*

## $RO_5$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 6, 6 | 19,17 | 28,16 | 123,135 |
| | + | 50,000 | 24,19 | 19,25 | 14,17 | 37,42 | 131,150 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 662 | | | | |
| | - | 1.0 | | | | | 759 |
| 9-Aminoacridine | - | 50 | | 260 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1591 | 927 | |
| 2-Anthramine | - | 1.0 | | | 31 | 24 | 165 |
| | + | 1.0 | | | 224 | 199 | 443 |
| | - | 2.5 | 44 | 9 | | | |
| | + | 2.5 | 233 | 103 | | | |
| $RO_5$ | | | | | | | |
| | - | 10 | 31 | 4 | 15 | 18 | 135 |
| | - | 50 | 22 | 9 | 11 | 19 | 145 |
| | - | 100* | 29 | 4 | 7 | 29 | 142 |
| | - | 500* | 32 | 19 | 16 | 23 | 155 |
| | - | 1000* | 32 | 16 | 22 | 41 | 116 |
| | - | 2500* | 19 | 20 | 23 | 36 | 166 |
| | + | 10 | 14 | 14 | 31 | 56 | 147 |
| | + | 50 | 15 | 19 | 59 | 85 | 202 |
| | + | 100* | 8 | 19 | 76 | 75 | 203 |
| | + | 500* | 6 | 20 | 72 | 108 | 269 |
| | + | 1000* | 8 | 28 | 93 | 121 | 316 |
| | + | 2500* | 11 | 21 | 87 | 132 | 271 |

---

* Formed precipitate when plated.

Table 2

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

$RO_5$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 27,41 | 13,19 | 20,19 | 39,42 | 166,171 |
| | + | 50,000 | 16,19 | 31,28 | 25,34 | 41,58 | 202,179 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 327 | | | | |
| | - | 1.0 | | | | | 511 |
| 9-Aminoacridine | - | 50 | | 487 | | | |
| 2-Nitrofluorene | - | 5 | | | 671 | 819 | |
| 2-Anthramine | + | 1.0 | | | 249 | 229 | 333 |
| | + | 2.5 | 329 | 461 | | | |
| $RO_5$ | - | 10 | 36 | 15 | 21 | 59 | 193 |
| | - | 50 | 52 | 20 | 8 | 61 | 178 |
| | - | 100* | 57 | 19 | 19 | 85 | 195 |
| | - | 500* | 77 | 23 | 27 | 77 | 266 |
| | - | 1000* | 66 | 22 | 19 | 90 | 272 |
| | - | 2500* | 64 | 27 | 18 | 35 | 219 |
| | + | 10 | 25 | 26 | 34 | 50 | 255 |
| | + | 50 | 18 | 37 | 45 | 83 | 359 |
| | + | 100* | 12 | 38 | 51 | 96 | 370 |
| | + | 500* | 13 | 30 | 39 | 145 | 423 |
| | + | 1000* | 10 | 36 | 47 | 161 | 386 |
| | + | 2500* | 18 | 34 | 73 | 165 | 354 |

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*Formed precipitate when plated.

Table 34

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

$RO_6$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 6, 6 | 19,17 | 28,16 | 123,135 |
| | + | 50,000 | 24,19 | 19,25 | 14,17 | 37,42 | 131,150 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 662 | | | | |
| | - | 1.0 | | | | | 759 |
| 9-Aminoacridine | - | 50 | | 260 | | | |
| 2-Nitrofluorene | - | 5 | | | 1591 | 927 | |
| 2-Anthramine | - | 1.0 | | | 31 | 24 | 165 |
| | + | 1.0 | | | 224 | 199 | 443 |
| | - | 2.5 | 44 | 9 | | | |
| | + | 2.5 | 233 | 103 | | | |
| $RO_6$ | - | 10 | 22 | 3 | 12 | 34 | 86 |
| | - | 50 | 23 | 15 | 14 | 22 | 103 |
| | - | 100 | 21 | 7 | 12 | 21 | 93 |
| | - | 500 | 23 | 12 | 9 | 27 | 89 |
| | - | 1000* | 19 | 8 | 13 | 22 | 103 |
| | - | 2500* | 18 | 4 | 9 | 27 | 119 |
| | + | 10 | 16 | 9 | 17 | 54 | 93 |
| | + | 50 | 11 | 10 | 25 | 46 | 121 |
| | + | 100 | 11 | 10 | 22 | 38 | 96 |
| | + | 500 | 14 | 15 | 37 | 47 | 142 |
| | + | 1000* | 12 | 11 | 32 | 54 | 142 |
| | + | 2500* | 12 | 8 | 26 | 46 | 103 |

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* Formed precipitate when plated.

## Table 4

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_6$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 27,41 | 13,19 | 20,19 | 39,42 | 166,171 |
| | + | 50,000 | 16,19 | 31,28 | 25,34 | 41,58 | 202,179 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 327 | | | | |
| | - | 1.0 | | | | | 511 |
| 9-Aminoacridine | - | 50 | | 487 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 671 | 819 | |
| 2-Anthramine | + | 1.0 | | | 249 | 229 | 333 |
| | + | 2.5 | 329 | 461 | | | |
| $RO_6$ | - | 10 | 38 | 11 | 16 | 42 | 186 |
| | - | 50 | 58 | 17 | 13 | 56 | 197 |
| | - | 100 | 55 | 15 | 15 | 65 | 199 |
| | - | 500 | 42 | 15 | 15 | 61 | 218 |
| | - | 1000* | 45 | 12 | 10 | 48 | 193 |
| | - | 2500* | 56 | 21 | 11 | 41 | 182 |
| | + | 10 | 17 | 40 | 36 | 55 | 222 |
| | + | 50 | 22 | 29 | 27 | 59 | 265 |
| | + | 100 | 19 | 28 | 31 | 62 | 277 |
| | + | 500 | 19 | 39 | 31 | 71 | 316 |
| | + | 1000* | 17 | 24 | 26 | 70 | 289 |
| | + | 2500 | 18 | 34 | 27 | 88 | 206 |

---

* Formed a precipitate when plated.

## Table 5

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_6$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Average Histidine Revertants per Plate[†] | | |
|---|---|---|---|---|---|
| | | | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | + | 50,000 | 34,37 | 43,41 | 135,127 |
| Positive controls | | | | | |
| Sodium azide | - | 1.0 | | | 531 |
| 2-Nitrofluorene | - | 5.0 | 1394 | 262 | |
| 2-Anthramine | + | 1.0 | 169 | 184 | 266 |
| $RO_6$ | + | 10 | 31 | 43 | 139 |
| | + | 50 | 27 | 51 | 161 |
| | + | 100 | 25 | 48 | 178 |
| | + | 500 | 41 | 51 | 190 |
| | + | 1000* | 44 | 48 | 183 |
| | + | 2500* | 48 | 51 | 163 |

---

* Formed precipitate when plated.

† Average of two plates.

## Table 6.

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
## RO$_6$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Average Histidine Revertants per Plate† | | |
|---|---|---|---|---|---|
| | | | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | + | 50,000 | 21,18 | 33,38 | 73,78 |
| Positive controls | | | | | |
| Sodium azide | - | 1.0 | | | 531 |
| 2-Nitrofluorene | - | 5.0 | 822 | 459 | |
| 2-Anthramine | + | 1.0 | 744 | 725 | 709 |
| RO$_6$ | + | 10 | 18 | 36 | 94 |
| | + | 50 | 24 | 39 | 95 |
| | + | 100 | 27 | 41 | 121 |
| | + | 500 | 40 | 57 | 165 |
| | + | 1000* | 42 | 69 | 169 |
| | + | 2500* | 44 | 56 | 136 |

---

* Formed precipitate when plated.

† Average of two plates.

## Table 7

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_7$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 6, 6 | 19,17 | 28,16 | 123,135 |
| | + | 50,000 | 24,19 | 19,25 | 14,17 | 37,42 | 131,150 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 662 | | | | |
| | - | 1.0 | | | | | 759 |
| 9-Aminoacridine | - | 50 | | 260 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1591 | 927 | |
| 2-Anthramine | - | 1.0 | | | 31 | 24 | 165 |
| | + | 1.0 | | | 224 | 199 | 443 |
| | - | 2.5 | 44 | 9 | | | |
| | + | 2.5 | 233 | 103 | | | |
| $RO_7$ | - | 10 | 26 | 7 | 17 | 24 | 141 |
| | - | 50 | 23 | 5 | 13 | 22 | 142 |
| | - | 100 | 23 | 5 | 19 | 35 | 148 |
| | - | 500* | 21 | 6 | 10 | 22 | 145 |
| | - | 1000* | 20 | 7 | 18 | 24 | 145 |
| | - | 2500* | 26 | 12 | 20 | 27 | 147 |
| | + | 10 | 13 | 12 | 19 | 42 | 133 |
| | + | 50 | 19 | 16 | 11 | 41 | 141 |
| | + | 100 | 18 | 18 | 19 | 33 | 129 |
| | + | 500* | 15 | 24 | 16 | 60 | 156 |
| | + | 1000* | 19 | 20 | 20 | 49 | 183 |
| | + | 2500* | 5 | 13 | 19 | 59 | 181 |

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* Formed precipitate when plated.

## Table 8

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_7$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 27,41 | 13,19 | 20,19 | 39,42 | 166,171 |
| | + | 50,000 | 16,19 | 31,28 | 25,34 | 41,58 | 202,179 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 327 | | | | |
| | - | 1.0 | | | | | 511 |
| 9-Aminoacridine | - | 50 | | 487 | | | |
| 2-Nitrofluorene | - | 5 | | | 671 | 819 | |
| 2-Anthramine | - | 1.0 | | | 249 | 229 | 333 |
| | + | 2.5 | | 329 | 461 | | |
| $RO_7$ | - | 10 | 49 | 13 | 17 | 46 | 204 |
| | - | 50 | 66 | 13 | 10 | 57 | 206 |
| | - | 100 | 57 | 19 | 13 | 38 | 222 |
| | - | 500* | 55 | 20 | 15 | 43 | 227 |
| | - | 1000* | 73 | 19 | 14 | 41 | 196 |
| | - | 2500* | 62 | 11 | 18 | 37 | 195 |
| | + | 10 | 26 | 30 | 32 | 46 | 207 |
| | + | 50 | 27 | 35 | 32 | 58 | 274 |
| | + | 100 | 27 | 45 | 33 | 58 | 264 |
| | + | 500* | 32 | 37 | 26 | 60 | 278 |
| | + | 1000* | 26 | 44 | 34 | 69 | 250 |
| | + | 2500* | 20 | 31 | 27 | 69 | 219 |

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* Formed precipitate when plated.

## Table 9

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_7$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Average Histidine Revertants per Plate[†]<br>TA98 |
|---|---|---|---|
| Negative control (dioxane) | + | 50,000 | 43,41 |
| Positive controls | | | |
| 2-Nitrofluorene | - | 5.0 | 262 |
| 2-Anthramine | + | 1.0 | 184 |
| $RO_7$ | + | 10 | 36 |
| | + | 50 | 42 |
| | + | 100 | 44 |
| | + | 500* | 63 |
| | + | 1000* | 58 |
| | + | 5000* | 58 |

---

* Formed a precipitate when plated.

[†] Average of two plates.

## Table 10

## *IN VITRO* ASSAYS WITH *SALMONELLA TYPHIMURIUM*

## $RO_7$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 32,29 | | | | |
| | + | 50,000 | | 3,12 | 21,18 | 33,38 | 73, 78 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 494 | | | | |
| | - | 1.0 | | | | | 531 |
| 9-Aminoacridine | - | 50 | | 112 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 822 | 459 | |
| 2-Anthramine | + | 1.0 | | | 744 | 725 | 709 |
| | + | 2.5 | 155 | 62 | | | |
| $RO_7$ | - | 10 | 28 | | | | |
| | - | 50 | 22 | | | | |
| | - | 100 | 29 | | | | |
| | - | 500* | 27 | | | | |
| | - | 1000* | 24 | | | | |
| | - | 2500* | 30 | | | | |
| | + | 10 | | 14 | | 40 | 100 |
| | + | 50 | | 12 | | 37 | 89 |
| | + | 100 | | 18 | | 41 | 106 |
| | + | 500* | | 22 | | 41 | 123 |
| | + | 1000* | | 21 | | 54 | 125 |
| | + | 2500* | | 11 | | 41 | 118 |

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* Formed precipitate when plated.

## Table 11

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_8$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 6, 6 | 19,17 | 28,16 | 123,135 |
| | + | 50,000 | 24,19 | 19,25 | 14,17 | 37,42 | 131,150 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 662 | | | | |
| | - | 1.0 | | | | | 759 |
| 9-Aminoacridine | - | 50 | | 260 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1591 | 927 | |
| 2-Anthramine | - | 1.0 | | | 31 | 24 | 165 |
| | + | 1.0 | | | 224 | 199 | 443 |
| | - | 2.5 | 44 | 9 | | | |
| | + | 2.5 | 233 | 103 | | | |
| $RO_8$ | - | 10 | 38 | 12 | 19 | 21 | 136 |
| | - | 50 | 44 | 13 | 14 | 24 | 117 |
| | - | 100* | 45 | 10 | 16 | 24 | 131 |
| | - | 500* | 40 | 14 | 13 | 19 | 131 |
| | - | 1000* | 40 | 8 | 10 | 20 | 140 |
| | - | 2500* | 47 | 11 | 18 | 26 | 114 |
| | + | 10 | 14 | 20 | 29 | 38 | 135 |
| | + | 50 | 16 | 21 | 38 | 52 | 127 |
| | + | 100* | 15 | 22 | 39 | 40 | 133 |
| | + | 500* | 23 | 34 | 53 | 53 | 161 |
| | + | 1000* | 15 | 33 | 48 | 50 | 128 |
| | + | 2500* | 25 | 22 | 49 | 53 | 160 |

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* Formed a precipitate when plated.

## Table 12

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_8$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 27,41 | 13,19 | 20,19 | 39,42 | 166,171 |
| | + | 50,000 | 16,19 | 31,28 | 25,34 | 41,58 | 202,179 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 327 | | | | |
| | - | 1.0 | | | | | 511 |
| 9-Aminoacridine | - | 50 | | 487 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 671 | 819 | |
| 2-Anthramine | + | 1.0 | | | 249 | 229 | 333 |
| | + | 2.5 | 329 | 461 | | | |
| $RO_8$ | - | 10 | 46 | 16 | 16 | 47 | 225 |
| | - | 50 | 63 | 19 | 11 | 49 | 216 |
| | - | 100* | 48 | 9 | 19 | 53 | 183 |
| | - | 500* | 70 | 9 | 13 | 66 | 197 |
| | - | 1000* | 70 | 19 | 23 | 43 | 170 |
| | - | 2500* | 65 | 13 | 16 | 30 | 164 |
| | + | 10 | 26 | 30 | 26 | 43 | 194 |
| | + | 50 | 22 | 35 | 33 | 42 | 168 |
| | + | 100* | 28 | 26 | 24 | 59 | 167 |
| | + | 500* | 16 | 35 | 43 | 67 | 206 |
| | + | 1000* | 29 | 37 | 29 | 57 | 216 |
| | + | 2500* | 23 | 31 | 30 | 75 | 223 |

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* Formed precipitate when plated.

## Table 13

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
## $RO_8$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Average Histidine Revertants per Plate† | |
|---|---|---|---|---|
| | | | TA1538 | TA100 |
| Negative control (dioxane) | + | 50,000 | 34,37 | 135,127 |
| Postive controls | | | | |
| 9-Aminoacridine | - | 50 | 1394 | |
| Sodium azide | - | 1.0 | | 531 |
| 2-Anthramine | + | 1.0 | 169 | 266 |
| $RO_8$ | + | 10 | 28 | 150 |
| | + | 50 | 35 | 165 |
| | + | 100* | 31 | 164 |
| | + | 500* | 31 | 152 |
| | + | 1000* | 31 | 171 |
| | + | 2500* | 34 | 153 |

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* Formed precipitate when plated.
† Average of two plates.

## Table 14

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
### $RO_9$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate TA1535 | TA1537 | TA1538 | TA98 | TA100 |
|---|---|---|---|---|---|---|---|
| Negative control (dioxane) | - | 50,000 | 41,38 | 6,6 | 19,17 | 28,16 | 123,135 |
| | + | 50,000 | 24,19 | 19,25 | 14,17 | 37,42 | 131,150 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 622 | | | | |
| | - | 1.0 | | | | | 759 |
| 9-Aminoacridine | - | 50 | | 260 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1591 | 927 | |
| 2-Anthramine | - | 1.0 | | | 31 | 24 | 165 |
| | + | 1.0 | | | 224 | 199 | 443 |
| | - | 2.5 | 44 | 9 | | | |
| | + | 2.5 | 233 | 103 | | | |
| $RO_9$ | - | 10 | 40 | 7 | 14 | 21 | 101 |
| | - | 50* | 32 | 8 | 15 | 25 | 139 |
| | - | 100* | 28 | 7 | 15 | 25 | 118 |
| | - | 500* | 42 | 12 | 18 | 33 | 119 |
| | - | 1000* | 33 | 22 | 19 | 37 | 147 |
| | - | 2500* | 47 | 20 | 27 | 33 | 127 |
| | + | 10 | 16 | 19 | 19 | 36 | 165 |
| | + | 50* | 16 | 17 | 28 | 54 | 151 |
| | + | 100* | 13 | 32 | 39 | 66 | 253 |
| | + | 500* | 15 | 46 | 76 | 98 | 274 |
| | + | 1000* | 16 | 28 | 109 | 109 | 256 |
| | + | 2500* | 13 | 37 | 164 | 111 | 231 |

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* Formed precipitate when plated.

## Table 15

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_9$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 27,41 | 13,19 | 20,19 | 39,42 | 166,171 |
| | + | 50,000 | 16,19 | 31,28 | 25,34 | 41,58 | 202,179 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 327 | | | | |
| | - | 1.0 | | | | | 511 |
| 9-Aminoacridine | - | 50 | | 487 | | | |
| 2-Nitrofluorene | - | 5 | | | 671 | 819 | |
| 2-Anthramine | + | 1.0 | | | 249 | 229 | 333 |
| | + | 2.5 | 329 | 461 | | | |
| $RO_9$ | - | 10 | 47 | 20 | 27 | 61 | 238 |
| | - | 50* | 43 | 15 | 21 | 70 | 276 |
| | - | 100* | 54 | 18 | 20 | 96 | 280 |
| | - | 500* | 58 | 36 | 15 | 147 | 310 |
| | - | 1000* | 62 | 30 | 22 | 131 | 333 |
| | - | 2500* | 56 | 35 | 18 | 62 | 230 |
| | + | 10 | 15 | 37 | 32 | 77 | 277 |
| | + | 50* | 23 | 45 | 37 | 111 | 286 |
| | + | 100* | 27 | 67 | 43 | 142 | 311 |
| | + | 500* | 19 | 63 | 51 | 159 | 356 |
| | + | 1000* | 26 | 52 | 64 | 191 | 344 |
| | + | 2500* | 20 | 47 | 95 | 222 | 267 |

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* Formed precipitate when plated.

## Table 16

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{10}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 53,41 | 15,16 | 20, 7 | 25,19 | 119,133 |
| | + | 50,000 | 22,13 | 21,21 | 35,43 | 35,40 | 134,121 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 360 | | | | |
| | - | 1.0 | | | | | 509 |
| 9-Aminoacridine | - | 50 | | 75 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1127 | 666 | |
| 2-Anthramine | - | 1.0 | | | 24 | 32 | 138 |
| | + | 1.0 | | | 171 | 134 | 275 |
| | - | 2.5 | 43 | 14 | | | |
| | + | 2.5 | 268 | 40 | | | |
| $RO_{10}$ | - | 10 | 33 | 5 | 12 | 23 | 117 |
| | - | 50 | 40 | 10 | 19 | 24 | 117 |
| | - | 100 | 32 | 10 | 14 | 16 | 95 |
| | - | 500* | 27 | 9 | 14 | 31 | 108 |
| | - | 1000* | 33 | 8 | 10 | 25 | 95 |
| | - | 2500* | 27 | 5 | 9 | 21 | 84 |
| | + | 10 | 21 | 14 | 31 | 24 | 114 |
| | + | 50 | 12 | 18 | 37 | 29 | 117 |
| | + | 100 | 9 | 15 | 22 | 34 | 120 |
| | + | 500* | 11 | 15 | 27 | 54 | 109 |
| | + | 1000* | 16 | 11 | 37 | 36 | 108 |
| | + | 2500* | 10 | 7 | 36 | 24 | 115 |

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* Formed precipitate when plated.

Table 17

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

$RO_{10}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate TA1535 | TA1537 | TA1538 | TA98 | TA100 |
|---|---|---|---|---|---|---|---|
| Negative control (dioxane) | - | 50,000 | 27,41 | 13,19 | 20,19 | 39,42 | 166,171 |
| | + | 50,000 | 16,19 | 31,28 | 25,34 | 41,58 | 202,179 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 327 | | | | |
| | - | 1.0 | | | | | 511 |
| 9-Aminoacridine | - | 50 | | 487 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 671 | 819 | |
| 2-Anthramine | + | 1.0 | | | 249 | 229 | 333 |
| | + | 2.5 | 329 | 461 | | | |
| $RO_{10}$ | - | 10 | 36 | 14 | 26 | 54 | 170 |
| | - | 50 | 38 | 18 | 26 | 38 | 148 |
| | - | 100 | 35 | 17 | 12 | 39 | 163 |
| | - | 500* | 52 | 14 | 19 | 33 | 134 |
| | - | 1000* | 50 | 14 | 16 | 25 | 153 |
| | - | 2500* | 52 | 10 | 21 | 34 | 147 |
| | + | 10 | 37 | 51 | 38 | 49 | 171 |
| | + | 50 | 15 | 52 | 38 | 45 | 181 |
| | + | 100 | 21 | 41 | 55 | 52 | 169 |
| | + | 500* | 19 | 40 | 37 | 56 | 184 |
| | + | 1000* | 22 | 35 | 41 | 51 | 185 |
| | + | 2500* | 17 | 31 | 38 | 56 | 111 |

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* Formed precipitate when plated.

## Table 18

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{11}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 53,41 | 15,16 | 20, 7 | 25,19 | 119,133 |
| | + | 50,000 | 22,13 | 21,21 | 35,43 | 35,40 | 134,121 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 360 | | | | |
| | - | 1.0 | | | | | 509 |
| 9-Aminoacridine | - | 50 | | 75 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1127 | 666 | |
| 2-Anthramine | - | 1.0 | | | 24 | 32 | 138 |
| | + | 1.0 | | | 171 | 134 | 275 |
| | - | 2.5 | 43 | 14 | | | |
| | + | 2.5 | 268 | 40 | | | |
| $RO_{11}$ | - | 10 | 40 | 6 | 19 | 20 | 129 |
| | - | 50 | 56 | 10 | 15 | 24 | 137 |
| | - | 100 | 45 | 6 | 14 | 27 | 121 |
| | - | 500* | 34 | 5 | 21 | 27 | 132 |
| | - | 1000* | 33 | 7 | 13 | 26 | 141 |
| | - | 2500* | 37 | 5 | 17 | 26 | 117 |
| | + | 10 | 14 | 14 | 28 | 41 | 139 |
| | + | 50 | 16 | 21 | 24 | 37 | 122 |
| | + | 100 | 14 | 10 | 29 | 27 | 130 |
| | + | 500* | 11 | 17 | 43 | 49 | 144 |
| | + | 1000* | 9 | 22 | 44 | 53 | 154 |
| | + | 2500* | 11 | 12 | 44 | 51 | 146 |

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* Formed precipitate when plated.

## Table 19

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{11}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate |  |  |  |  |
|---|---|---|---|---|---|---|---|
|  |  |  | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 27,41 | 13,19 | 20,19 | 39,42 | 166,171 |
|  | + | 50,000 | 16,19 | 31,28 | 25,34 | 41,58 | 202,179 |
| Positive controls |  |  |  |  |  |  |  |
| Sodium azide | - | 0.5 | 327 |  |  |  |  |
|  | - | 1.0 |  |  |  |  | 511 |
| 9-Aminoacridine | - | 50 |  | 487 |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  | 671 | 819 |  |
| 2-Anthramine | + | 1.0 |  |  | 249 | 229 | 333 |
|  | + | 2.5 | 329 | 461 |  |  |  |
| $RO_{11}$ | - | 10 | 42 | 10 | 19 | 29 | 165 |
|  | - | 50 | 39 | 13 | 15 | 40 | 173 |
|  | - | 100 | 49 | 13 | 17 | 40 | 169 |
|  | - | 500* | 50 | 16 | 20 | 27 | 143 |
|  | - | 1000* | 33 | 16 | 32 | 33 | 157 |
|  | - | 2500* | 54 | 18 | 22 | 31 | 134 |
|  | + | 10 | 32 | 39 | 40 | 62 | 178 |
|  | + | 50 | 30 | 46 | 48 | 67 | 205 |
|  | + | 100 | 26 | 56 | 44 | 67 | 205 |
|  | + | 500* | 26 | 42 | 49 | 61 | 189 |
|  | + | 1000* | 26 | 43 | 47 | 65 | 217 |
|  | + | 2500* | 23 | 35 | 49 | 66 | 186 |

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* Formed precipitate when plated.

## Table 20

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{12}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 53,41 | 15,16 | 20, 7 | 25,19 | 119,133 |
| | + | 50,000 | 22,13 | 21,21 | 35,43 | 35,40 | 134,121 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 360 | | | | |
| | - | 1.0 | | | | | 509 |
| 9-Aminoacridine | - | 50 | | 75 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1127 | 666 | |
| 2-Anthramine | - | 1.0 | | | 24 | 32 | 138 |
| | + | 1.0 | | | 171 | 134 | 275 |
| | - | 2.5 | 43 | 14 | | | |
| | + | 2.5 | 268 | 40 | | | |
| $RO_{12}$ | - | 10 | 45 | 7 | 6 | 27 | 125 |
| | - | 50* | 33 | 6 | 9 | 30 | 116 |
| | - | 100* | 33 | 11 | 12 | 30 | 114 |
| | - | 500* | 35 | 9 | 15 | 23 | 109 |
| | - | 1000* | 38 | 14 | 10 | 24 | 123 |
| | - | 2500* | 41 | 9 | 12 | 15 | 101 |
| | + | 10 | 10 | 19 | 31 | 34 | 118 |
| | + | 50* | 16 | 19 | 42 | 48 | 139 |
| | + | 100* | 9 | 15 | 27 | 51 | 135 |
| | + | 500* | 10 | 16 | 35 | 53 | 148 |
| | + | 1000* | 11 | 16 | 34 | 55 | 152 |
| | + | 2500* | 11 | 14 | 49 | 56 | 113 |

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* Formed precipitate when plated.

## Table 21

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{12}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 27,41 | 13,19 | 20,19 | 39,42 | 166,171 |
| | + | 50,000 | 16,19 | 31,28 | 25,34 | 41,58 | 202,179 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 327 | | | | |
| | - | 1.0 | | | | | 511 |
| 9-Aminoacridine | - | 50 | | 487 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 671 | 819 | |
| 2-Anthramine | + | 1.0 | | | 249 | 229 | 333 |
| | + | 2.5 | 329 | 461 | | | |
| $RO_{12}$ | - | 10 | 39 | 6 | 20 | 31 | 154 |
| | - | 50* | 35 | 10 | 12 | 34 | 143 |
| | - | 100* | 21 | 7 | 8 | 36 | 141 |
| | - | 500* | 38 | 9 | 17 | 42 | 147 |
| | - | 1000* | 34 | 18 | 14 | 24 | 129 |
| | - | 2500* | 35 | 11 | 21 | 21 | 142 |
| | + | 10 | 10 | 36 | 42 | 53 | 190 |
| | + | 50* | 16 | 46 | 31 | 53 | 160 |
| | + | 100* | 18 | 38 | 31 | 61 | 184 |
| | + | 500* | 18 | 35 | 46 | 57 | 171 |
| | + | 1000* | 24 | 27 | 54 | 41 | 162 |
| | + | 2500* | 19 | 17 | 41 | 45 | 119 |

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* Formed precipitate when plated.

## Table 22

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{13}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 53,41 | 15,16 | 20, 7 | 25,19 | 119,133 |
| | + | 50,000 | 22,13 | 21,21 | 35,43 | 35,40 | 134,121 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 360 | | | | |
| | - | 1.0 | | | | | 509 |
| 9-Aminoacridine | - | 50 | | 75 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1127 | 666 | |
| 2-Anthramine | - | 1.0 | | | 24 | 32 | 138 |
| | + | 1.0 | | | 171 | 134 | 275 |
| | - | 2.5 | 43 | 14 | | | |
| | + | 2.5 | 268 | 40 | | | |
| $RO_{13}$ | - | 10* | 33 | 16 | 23 | 22 | 131 |
| | - | 50* | 49 | 9 | 8 | 21 | 141 |
| | - | 100* | 34 | 12 | 14 | 36 | 135 |
| | - | 500* | 39 | 8 | 18 | 30 | 129 |
| | - | 1000* | 43 | 10 | 15 | 24 | 149 |
| | - | 2500* | 21 | 8 | 15 | 29 | 132 |
| | + | 10* | 16 | 20 | 51 | 36 | 134 |
| | + | 50* | 16 | 21 | 44 | 59 | 145 |
| | + | 100* | 17 | 27 | 37 | 52 | 188 |
| | + | 500* | 14 | 24 | 46 | 68 | 205 |
| | + | 1000* | 11 | 26 | 70 | 70 | 196 |
| | + | 2500* | 13 | 24 | 63 | 71 | 147 |

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* Formed precipitate when plated.

## Table 23

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{13}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate TA1535 | TA1537 | TA1538 | TA98 | TA100 |
|---|---|---|---|---|---|---|---|
| Negative control (dioxane) | - | 50,000 | 27,41 | 13,19 | 20,19 | 39,42 | 166,171 |
|  | + | 50,000 | 16,19 | 31,28 | 25,34 | 41,58 | 202,179 |
| Positive controls |  |  |  |  |  |  |  |
| Sodium azide | - | 0.5 | 327 |  |  |  |  |
|  | - | 1.0 |  |  |  |  | 511 |
| 9-Aminoacridine | - | 50 |  | 487 |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  | 671 | 819 |  |
| 2-Anthramine | + | 1.0 |  |  | 249 | 229 | 333 |
|  | + | 2.5 | 329 | 461 |  |  |  |
| $RO_{13}$ | - | 10 | 30 | 8 | 26 | 43 | 143 |
|  | - | 50* | 35 | 14 | 38 | 35 | 154 |
|  | - | 100* | 49 | 15 | 36 | 44 | 175 |
|  | - | 500* | 36 | 17 | 37 | 33 | 147 |
|  | - | 1000* | 53 | 12 | 29 | 38 | 137 |
|  | - | 2500* | 50 | 9 | 27 | 32 | 132 |
|  | + | 10 | 29 | 29 | 56 | 72 | 166 |
|  | + | 50* | 28 | 44 | 68 | 60 | 168 |
|  | + | 100* | 18 | 30 | 50 | 68 | 141 |
|  | + | 500* | 21 | 36 | 58 | 91 | 138 |
|  | + | 1000* | 16 | 33 | 43 | 110 | 145 |
|  | + | 2500* | 9 | 23 | 43 | 75 | 159 |

---

* Formed precipitate when plated.

## Table 24

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{13}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Average Histidine Revertants per Plate[†] | | |
|---|---|---|---|---|---|
| | | | TA1533 | TA98 | TA100 |
| Negative control (dioxane) | + | 50,000 | 34,37 | 43,41 | 135,127 |
| Positive controls | | | | | |
| Sodium azide | - | 1.0 | | | 531 |
| 2-Nitrofluorene | - | 5.0 | 1394 | 262 | |
| 2-Anthramine | + | 1.0 | 169 | 184 | 266 |
| $RO_{13}$ | + | 10 | 27 | 44 | 137 |
| | + | 50* | 36 | 63 | 152 |
| | + | 100* | 36 | 66 | 165 |
| | + | 500* | 42 | 79 | 198 |
| | + | 1000* | 43 | 75 | 193 |
| | + | 2500* | 50 | 70 | 189 |

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* Formed precipitate when plated.

† Average of two plates.

## Table 25

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{13}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Average Histidine Revertants per Plate† | | |
|---|---|---|---|---|---|
| | | | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | + | 50,000 | 21,18 | 33,38 | 73, 78 |
| Positive controls | | | | | |
| Sodium azide | - | 1.0 | | | 531 |
| 2-Nitrofluorene | - | 5.0 | 822 | 459 | |
| 2-Anthramine | + | 1.0 | 744 | 725 | 709 |
| $RO_{13}$ | + | 10 | 24 | 35 | 89 |
| | + | 50* | 29 | 35 | 117 |
| | + | 100* | 31 | 51 | 120 |
| | + | 500* | 43 | 69 | 137 |
| | + | 1000* | 62 | 64 | 147 |
| | + | 2500* | 60 | 65 | 121 |

---

* Formed precipitate when plated.
† Average of two plates.

## Table 26

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{14}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 53,41 | 15,16 | 20, 7 | 25,19 | 119,133 |
| | + | 50,000 | 22,13 | 21,21 | 35,43 | 35,40 | 134,121 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 360 | | | | |
| | - | 1.0 | | | | | 509 |
| 9-Aminoacridine | - | 50 | | 75 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1127 | 666 | |
| 2-Anthramine | - | 1.0 | | | 24 | 32 | 138 |
| | + | 1.0 | | | 171 | 134 | 275 |
| | - | 2.5 | 43 | 14 | | | |
| | + | 2.5 | 268 | 40 | | | |
| $RO_{14}$ | - | 10 | 52 | 7 | 19 | 24 | 148 |
| | - | 50* | 46 | 10 | 16 | 34 | 142 |
| | - | 100* | 46 | 11 | 18 | 31 | 145 |
| | - | 500* | 33 | 8 | 16 | 32 | 131 |
| | - | 1000* | 31 | 5 | 20 | 26 | 144 |
| | - | 2500* | 41 | 8 | 17 | 28 | 139 |
| | + | 10 | 10 | 17 | 29 | 43 | 137 |
| | + | 50* | 20 | 21 | 29 | 51 | 155 |
| | + | 100* | 15 | 22 | 30 | 39 | 183 |
| | + | 500* | 13 | 20 | 51 | 62 | 221 |
| | + | 1000* | 14 | 20 | 67 | 69 | 243 |
| | + | 2500* | 10 | 17 | 33 | 62 | 208 |

---

* Formed precipitate when plated.

## Table 27

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{14}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 27,41 | 13,19 | 20,19 | 39,42 | 166,171 |
| | + | 50,000 | 16,19 | 31,28 | 25,34 | 41,58 | 202,179 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 327 | | | | |
| | - | 1.0 | | | | | 511 |
| 9-Aminoacridine | - | 50 | | 487 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 671 | 819 | |
| 2-Anthramine | + | 1.0 | | | 249 | 229 | 333 |
| | + | 2.5 | 329 | 461 | | | |
| $RO_{14}$ | - | 10 | 45 | 19 | 16 | 33 | 192 |
| | - | 50* | 56 | 21 | 14 | 43 | 158 |
| | - | 100* | 48 | 9 | 11 | 64 | 176 |
| | - | 500* | 56 | 18 | 12 | 54 | 175 |
| | - | 1000* | 44 | 12 | 22 | 43 | 169 |
| | - | 2500* | 54 | 7 | 19 | 33 | 149 |
| | + | 10 | 29 | 39 | 25 | 55 | 211 |
| | + | 50* | 28 | 37 | 27 | 59 | 216 |
| | + | 100* | 27 | 28 | 36 | 60 | 201 |
| | + | 500* | 31 | 24 | 22 | 85 | 260 |
| | + | 1000* | 19 | 30 | 35 | 79 | 253 |
| | + | 2500* | 29 | 35 | 45 | 65 | 214 |

---

* Formed precipitate when plated.

## Table 28

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{14}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Average Histidine Revertants per Plate† TA1538 | TA98 | TA100 |
|---|---|---|---|---|---|
| Negative control (dioxane) | + | 50,000 | 34,37 | 43,41 | 135,127 |
| Positive controls | | | | | |
| Sodium azide | – | 1.0 | | | 531 |
| 2-Nitrofluorene | – | 5.0 | 1394 | 262 | |
| 2-Anthramine | + | 1.0 | 169 | 184 | 266 |
| $RO_{14}$ | + | 10 | 29 | 38 | 135 |
| | + | 50* | 34 | 56 | 159 |
| | + | 100* | 34 | 71 | 175 |
| | + | 500* | 45 | 81 | 213 |
| | + | 1000* | 44 | 72 | 186 |
| | + | 2500* | 48 | 69 | 160 |

---

* Formed a precipitate when plated.

† Average of two plates.

## Table 29

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{14}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Average Histidine Revertants per Plate† | | |
|---|---|---|---|---|---|
| | | | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | + | 50,000 | 21,18 | 33,38 | 73, 78 |
| Positive controls | | | | | |
| Sodium azide | - | 1.0 | | | 531 |
| 2-Nitrofluorene | - | 5.0 | 822 | 459 | |
| 2-Anthramine | + | 1.0 | 744 | 725 | 709 |
| $RO_{14}$ | + | 10 | 19 | 30 | 72 |
| | + | 50* | 20 | 39 | 94 |
| | + | 100* | 28 | 47 | 104 |
| | + | 500* | 51 | 67 | 124 |
| | + | 1000* | 52 | 75 | 132 |
| | + | 2500* | 48 | 59 | 93 |

---

* Formed precipitate when plated.

† Average of two plates.

## Table 30

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{15}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 56,50 | 7,13 | 19,13 | 39,17 | 155,152 |
| | + | 50,000 | 20,18 | 21,17 | 21,48 | 41,33 | 131,138 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 501 | | | | |
| | - | 1.0 | | | | | 700 |
| 9-Aminoacridine | - | 50 | | 568 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1490 | 1101 | |
| 2-Anthramine | - | 1.0 | | | 14 | 45 | 137 |
| | + | 1.0 | | | 209 | 246 | 421 |
| | - | 2.5 | 44 | 19 | | | |
| | + | 2.5 | 493 | 435 | | | |
| $RO_{15}$ | - | 10 | 11 | 5 | 9 | 21 | 74 |
| | - | 50 | 9 | 5 | 8 | 22 | 88 |
| | - | 100* | 16 | 8 | 21 | 14 | 109 |
| | - | 500* | 13 | 16 | 16 | 23 | 99 |
| | - | 1000* | 14 | 23 | 13 | 33 | 124 |
| | - | 2500* | 14 | 31 | 16 | 18 | 121 |
| | + | 10 | 4 | 6 | 20 | 28 | 105 |
| | + | 50 | 10 | 15 | 39 | 72 | 150 |
| | + | 100* | 7 | 26 | 44 | 84 | 174 |
| | + | 500* | 8 | 24 | 103 | 110 | 273 |
| | + | 1000* | 10 | 34 | 78 | 131 | 266 |
| | + | 2500* | 7 | 30 | 120 | 132 | 263 |

---

* Formed precipitate when plated.

## Table 31

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{15}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 9,13 | 8, 7 | 41,49 | 207,200 |
| | + | 50,000 | 8,16 | 3,14 | 20,17 | 38,40 | 213,176 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 387 | | | | |
| | - | 1.0 | | | | | 634 |
| 9-Aminoacridine | - | 50 | | 213 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 907 | 679 | |
| 2-Anthramine | + | 1.0 | | | 316 | 166 | 292 |
| | + | 2.5 | 142 | 51 | | | |
| $RO_{15}$ | - | 10 | 39 | 8 | 14 | 45 | 213 |
| | - | 50 | 29 | 10 | 14 | 40 | 152 |
| | - | 100 | 32 | 10 | 11 | 56 | 158 |
| | - | 500* | 27 | 10 | 28 | 86 | 179 |
| | - | 1000* | 33 | 15 | 32 | 71 | 185 |
| | - | 2500* | 30 | 14 | 22 | 56 | 174 |
| | + | 10 | 16 | 15 | 40 | 64 | 221 |
| | + | 50 | 23 | 16 | C† | 92 | 237 |
| | + | 100 | 9 | 10 | 34 | 128 | 236 |
| | + | 500* | 9 | 21 | 46 | 142 | 205 |
| | + | 1000* | 7 | 22 | 57 | 168 | 260 |
| | + | 2500* | 5 | C | 66 | 130 | 212 |

---

* Formed precipitate when plated.

† C, contaminated.

## Table 32

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{15}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Average Histidine Revertants per Plate[†] | | |
|---|---|---|---|---|---|
| | | | TA1537 | TA1538 | TA100 |
| Negative control (dioxane) | + | 50,000 | 24,32 | 34,37 | 135,127 |
| Positive controls | | | | | |
| Sodium azide | - | 1.0 | | | 531 |
| 9-Aminoacridine | - | 50 | 282 | | |
| 2-Nitrofluorene | - | 5.0 | | 1394 | |
| 2-Anthramine | + | 1.0 | | 169 | 266 |
| | + | 2.5 | 136 | | |
| $RO_{15}$ | + | 10 | 42 | 26 | 157 |
| | + | 50 | 32 | 47 | 230 |
| | + | 100* | 42 | 46 | 230 |
| | + | 500* | 49 | 82 | 261 |
| | + | 1000* | 38 | 92 | 266 |
| | + | 2500* | 32 | 96 | 268 |

---

* Formed precipitate when plated.

† Average of two plates.

Table 33

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

$RO_{15}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Average Histidine Revertants per Plate† | | |
|---|---|---|---|---|---|
| | | | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | + | 50,000 | 21,18 | 33,38 | 73, 78 |
| Positive controls | | | | | |
| Sodium azide | - | 1.0 | | | 531 |
| 2-Nitrofluorene | - | 5.0 | 822 | 459 | |
| 2-Anthramine | + | 1.0 | 744 | 725 | 709 |
| $RO_{15}$ | + | 10 | 13 | 24 | 79 |
| | + | 50* | 27 | 28 | 101 |
| | + | 100* | 23 | 44 | 104 |
| | + | 500* | 37 | 43 | 118 |
| | + | 1000* | 61 | 61 | 124 |
| | + | 2500* | 70 | 45 | 127 |

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* Formed precipitate when plated.

† Average of two plates.

Table 34

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO$_{16}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate TA1535 | TA1537 | TA1538 | TA98 | TA100 |
|---|---|---|---|---|---|---|---|
| Negative control (dioxane) | - | 50,000 | 56,50 | 7,13 | 19,13 | 39,17 | 155,152 |
|  | + | 50,000 | 20,18 | 21,17 | 21,48 | 41,33 | 131,138 |
| Positive controls |  |  |  |  |  |  |  |
| Sodium azide | - | 0.5 | 501 |  |  |  |  |
|  | - | 1.0 |  |  |  |  | 700 |
| 9-Aminoacridine | - | 50 |  | 568 |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  | 1490 | 1101 |  |
| 2-Anthramine | - | 1.0 |  |  | 14 | 45 | 137 |
|  | + | 1.0 |  |  | 209 | 246 | 421 |
|  | - | 2.5 | 44 | 19 |  |  |  |
|  | + | 2.5 | 493 | 435 |  |  |  |
| RO$_{16}$ | - | 10 | 21 | 10 | 8 | 27 | 98 |
|  | - | 50 | 29 | 13 | 8 | 19 | 101 |
|  | - | 100 | 46 | 11 | 26 | 26 | 98 |
|  | - | 500* | 60 | 19 | 28 | 29 | 107 |
|  | - | 1000* | 40 | 26 | 17 | 37 | 123 |
|  | - | 2500* | 42 | 39 | 26 | 34 | 158 |
|  | + | 10 | 12 | 15 | 19 | 42 | 122 |
|  | + | 50 | 15 | 23 | 108 | 99 | 140 |
|  | + | 100 | 13 | 38 | 121 | 109 | 197 |
|  | + | 500* | 16 | 34 | 177 | 205 | 257 |
|  | + | 1000* | 14 | 51 | 212 | 293 | 211 |
|  | + | 2500* | 13 | 50 | 224 | 319 | 209 |

---

* Formed precipitate when plated.

# Table 35

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{16}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 9,13 | 8, 7 | 41,49 | 207,200 |
| | + | 50,000 | 8,16 | 3,14 | 20,17 | 38,40 | 213,176 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 387 | | | | |
| | - | 1.0 | | | | | 634 |
| 9-Aminoacridine | - | 50 | | 213 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 907 | 679 | |
| 2-Anthramine | + | 1.0 | | | 316 | 166 | 292 |
| | + | 2.5 | 142 | 51 | | | |
| $RO_{16}$ | - | 10 | 40 | 13 | 17 | 53 | 188 |
| | - | 50 | 31 | 8 | 12 | 59 | 185 |
| | - | 100 | 35 | 7 | 21 | 50 | 248 |
| | - | 500* | 37 | 8 | 48 | 63 | 251 |
| | - | 1000* | 36 | 13 | 50 | 117 | 242 |
| | - | 2500* | 32 | 29 | 37 | 100 | 271 |
| | + | 10 | 12 | 7 | 31 | 73 | 209 |
| | + | 50 | 12 | 17 | 62 | 136 | 292 |
| | + | 100 | 13 | 19 | 74 | 171 | 307 |
| | + | 500* | 8 | 25 | 110 | 241 | 364 |
| | + | 1000* | 15 | 19 | 87 | 265 | 391 |
| | + | 2500* | 7 | 26 | 115 | 299 | 242 |

---

* Formed precipitate when plated.

## Table 36

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{17}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 56,50 | 7,13 | 19,13 | 39,17 | 155,152 |
| | + | 50,000 | 20,18 | 21,17 | 21,48 | 41,33 | 131,138 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 501 | | | | |
| | - | 1.0 | | | | | 700 |
| 9-Aminoacridine | - | 50 | | 568 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1490 | 1101 | |
| 2-Anthramine | - | 1.0 | | | 14 | 45 | 137 |
| | + | 1.0 | | | 209 | 246 | 421 |
| | - | 2.5 | 44 | 19 | | | |
| | + | 2.5 | 493 | 435 | | | |
| $RO_{17}$ | - | 10 | 48 | 13 | 19 | 24 | 148 |
| | - | 50 | 56 | 7 | 12 | 36 | 134 |
| | - | 100 | 43 | 11 | 18 | 41 | 128 |
| | - | 500* | 50 | 6 | 15 | 28 | 134 |
| | - | 1000* | 56 | 11 | 21 | 31 | 125 |
| | - | 2500* | 52 | 13 | 16 | 30 | 124 |
| | + | 10 | 21 | 41 | 36 | 57 | 117 |
| | + | 50 | 15 | 28 | 25 | 60 | 147 |
| | + | 100 | 14 | 36 | 25 | 50 | 152 |
| | + | 500* | 12 | 32 | 48 | 75 | 128 |
| | + | 1000* | 12 | 40 | 41 | 55 | 151 |
| | + | 2500* | 20 | 37 | 61 | 76 | 148 |

---

* Formed precipitate when plated.

## Table 37

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{17}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate |  |  |  |  |
|---|---|---|---|---|---|---|---|
|  |  |  | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 9,13 | 8, 7 | 41,49 | 207,200 |
|  | + | 50,000 | 8,16 | 3,14 | 20,17 | 38,40 | 213,176 |
| Positive controls |  |  |  |  |  |  |  |
| Sodium azide | - | 0.5 | 387 |  |  |  |  |
|  | - | 1.0 |  |  |  |  | 634 |
| 9-Aminoacridine | - | 50 |  | 213 |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  | 907 | 679 |  |
| 2-Anthramine | + | 1.0 |  |  | 317 | 166 | 292 |
|  | + | 2.5 | 142 | 51 |  |  |  |
| $RO_{17}$ | - | 10 | 22 | 6 | 11 | 44 | 161 |
|  | - | 50 | 39 | 4 | 15 | 37 | 171 |
|  | - | 100 | 30 | 3 | 14 | 43 | 153 |
|  | - | 500 | 21 | 6 | 11 | 47 | 143 |
|  | - | 1000* | 13 | 11 | 9 | 31 | 159 |
|  | - | 2500* | C† | 1 | 14 | 27 | 139 |
|  | + | 10 | 5 | 4 | 14 | 34 | 150 |
|  | + | 50 | 10 | 6 | 16 | 32 | 154 |
|  | + | 100 | 8 | 7 | 10 | 44 | 164 |
|  | + | 500 | 8 | 10 | 23 | 43 | 186 |
|  | + | 1000* | 9 | 6 | 21 | 48 | 160 |
|  | + | 2500* | 6 | 6 | 18 | 37 | 171 |

---

* Formed precipitate when plated.

† C, contaminated.

Table 38

# IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

$RO_{18}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 56,50 | 7,13 | 19,13 | 39,17 | 155,152 |
| | + | 50,000 | 20,18 | 21,17 | 21,48 | 41,33 | 131,138 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 501 | | | | |
| | - | 1.0 | | | | | 700 |
| 9-Aminoacridine | - | 50 | | 568 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1490 | 1101 | |
| 2-Anthramine | - | 1.0 | | | 14 | 45 | 137 |
| | + | 1.0 | | | 209 | 246 | 421 |
| | - | 2.5 | 44 | 19 | | | |
| | + | 2.5 | 493 | 435 | | | |
| $RO_{18}$ | - | 10 | 72 | 16 | 24 | 35 | 109 |
| | - | 50 | 82 | 10 | 18 | 31 | 121 |
| | - | 100 | 64 | 11 | 27 | 38 | 142 |
| | - | 500* | 62 | 14 | 18 | 42 | 114 |
| | - | 1000* | 65 | 14 | 27 | 45 | 108 |
| | - | 2500* | 64 | 10 | 22 | 58 | 138 |
| | + | 10 | 20 | 31 | 27 | 57 | 143 |
| | + | 50 | 24 | 39 | 29 | 66 | 153 |
| | + | 100 | 30 | 47 | 47 | 80 | 161 |
| | + | 500* | 28 | 49 | 42 | 101 | 209 |
| | + | 1000* | 23 | 62 | 51 | 71 | 213 |
| | + | 2500* | 26 | 47 | 69 | 117 | 258 |

---

* Formed precipitate when plated.

## Table 39

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{18}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 9,13 | 8, 7 | 41,49 | 207,200 |
| | + | 50,000 | 8,16 | 3,14 | 20,17 | 38,40 | 213,176 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 387 | | | | |
| | - | 1.0 | | | | | 634 |
| 9-Aminoacridine | - | 50 | | 213 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 907 | 679 | |
| 2-Anthramine | + | 1.0 | | | 316 | 166 | 292 |
| | + | 2.5 | 142 | 51 | | | |
| $RO_{18}$ | - | 10 | 29 | 6 | 11 | 46 | 163 |
| | - | 50 | 37 | 7 | 18 | 46 | 183 |
| | - | 100 | 29 | 10 | 16 | 58 | 191 |
| | - | 500 | 26 | 8 | 19 | 51 | 200 |
| | - | 1000* | 31 | 6 | 13 | 40 | 179 |
| | - | 2500* | 28 | 7 | 12 | 37 | 176 |
| | + | 10 | 11 | 11 | 16 | 41 | 192 |
| | + | 50 | 8 | 6 | 21 | 44 | 196 |
| | + | 100 | 8 | 12 | 30 | 50 | 202 |
| | + | 500 | 11 | 13 | 31 | 71 | 236 |
| | + | 1000* | 4 | 14 | 41 | 108 | 221 |
| | + | 2500* | 4 | 16 | 31 | 70 | 192 |

---

* Formed precipitate when plated.

## Table 40

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{19}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 56,50 | 7,13 | 19,13 | 39,17 | 155,152 |
| | + | 50,000 | 20,18 | 21,17 | 21,48 | 41,33 | 131,138 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 501 | | | | |
| | - | 1.0 | | | | | 700 |
| 9-Aminoacridine | - | 50 | | 568 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1490 | 1101 | |
| 2-Anthramine | - | 1.0 | | | 14 | 45 | 137 |
| | + | 1.0 | | | 209 | 246 | 421 |
| | - | 2.5 | 44 | 19 | | | |
| | + | 2.5 | 493 | 435 | | | |
| $RO_{19}$ | - | 10 | 41 | 14 | 18 | 46 | 127 |
| | - | 50 | 63 | 10 | 22 | 28 | 119 |
| | - | 100 | 69 | 13 | 17 | 27 | 128 |
| | - | 500* | 61 | 12 | 24 | 40 | 144 |
| | - | 1000* | 72 | 13 | 26 | 42 | 139 |
| | - | 2500* | 77 | 12 | 21 | 38 | 154 |
| | + | 10 | 13 | 21 | 43 | 68 | 143 |
| | + | 50 | 20 | 18 | 40 | 59 | 152 |
| | + | 100 | 16 | 27 | 44 | 56 | 147 |
| | + | 500* | 15 | 18 | 46 | 70 | 206 |
| | + | 1000* | 27 | 35 | 52 | 75 | 185 |
| | + | 2500* | 27 | 29 | 52 | 79 | 175 |

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* Formed precipitate when plated.

## Table 41

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{19}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 9,13 | 8, 7 | 41,49 | 207,200 |
| | + | 50,000 | 8,16 | 3,14 | 20,17 | 38,40 | 213,176 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 387 | | | | |
| | - | 1.0 | | | | | 634 |
| 9-Aminoacridine | - | 50 | | 213 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 907 | 679 | |
| 2-Anthramine | + | 1.0 | | | 316 | 166 | 292 |
| | + | 2.5 | 142 | 51 | | | |
| $RO_{19}$ | - | 10 | 46 | 11 | 13 | 44 | 212 |
| | - | 50 | 34 | 7 | 15 | 50 | 204 |
| | - | 100 | 31 | 11 | 9 | 39 | 224 |
| | - | 500* | 34 | 8 | 15 | 45 | 205 |
| | - | 1000* | 35 | 4 | 19 | 46 | 199 |
| | - | 2500* | 41 | 11 | 13 | 31 | 179 |
| | + | 10 | 12 | 6 | 22 | 49 | 174 |
| | + | 50 | 14 | 5 | 24 | 58 | 206 |
| | + | 100 | 11 | 6 | 31 | 50 | 234 |
| | + | 500* | 10 | 13 | 21 | 64 | 224 |
| | + | 1000* | 12 | 9 | 21 | 64 | 248 |
| | + | 2500* | 14 | 6 | 21 | 53 | 209 |

---

* Formed precipitate when plated.

## Table 42

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
## $RO_{19}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Average Histidine Revertants per Plate | | |
|---|---|---|---|---|---|
| | | | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | + | 50,000 | 34,37 | 43,41 | 135,127 |
| Positive controls | | | | | |
| Sodium azide | - | 1.0 | | | 531 |
| 2-Nitrofluorene | - | 5.0 | 1394 | 262 | |
| 2-Anthramine | + | 2.5 | 169 | 184 | 266 |
| $RO_{19}$ | + | 10 | 33 | 56 | 140 |
| | + | 50 | 30 | 52 | 142 |
| | + | 100 | 29 | 50 | 152 |
| | + | 500* | 31 | 59 | 169 |
| | + | 1000* | 36 | 59 | 173 |
| | + | 2500* | 44 | 57 | 166 |

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* Formed precipitate when plated.

## Table 43

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{20}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 56,50 | 7,13 | 19,13 | 39,17 | 155,152 |
| | + | 50,000 | 20,18 | 21,17 | 21,48 | 41,33 | 131,138 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 501 | | | | |
| | - | 1.0 | | | | | 700 |
| 9-Aminoacridine | - | 50 | | 568 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1490 | 1101 | |
| 2-Anthramine | - | 1.0 | | | 14 | 45 | 137 |
| | + | 1.0 | | | 209 | 246 | 421 |
| | - | 2.5 | 44 | 19 | | | |
| | + | 2.5 | 493 | 435 | | | |
| $RO_{20}$ | - | 10 | 60 | 8 | 18 | 32 | 125 |
| | - | 50 | 67 | 14 | 13 | 33 | 121 |
| | - | 100 | 88 | 14 | 17 | 36 | 147 |
| | - | 500* | 71 | 13 | 16 | 54 | 162 |
| | - | 1000* | 74 | 32 | 33 | 54 | 201 |
| | - | 2500* | 55 | 55 | 64 | 60 | 199 |
| | + | 10 | 17 | 30 | 26 | 90 | 137 |
| | + | 50 | 19 | 35 | 42 | 93 | 200 |
| | + | 100 | 20 | 52 | 49 | 110 | 239 |
| | + | 500* | 24 | 54 | 80 | 147 | 351 |
| | + | 1000* | 25 | 60 | 98 | 156 | 380 |
| | + | 2500* | 22 | 61 | 89 | 144 | 374 |

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* Formed precipitate when plated.

## Table 44

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{20}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 9,13 | 8, 7 | 41,49 | 207,200 |
| | + | 50,000 | 8,16 | 3,14 | 20,17 | 38,40 | 213,176 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 387 | | | | |
| | - | 1.0 | | | | | 634 |
| 9-Aminoacridine | - | 50 | | 213 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 907 | 679 | |
| 2-Anthramine | + | 1.0 | | | 316 | 166 | 292 |
| | + | 2.5 | 142 | 51 | | | |
| $RO_{20}$ | - | 10 | 27 | 9 | 14 | 36 | 177 |
| | - | 50 | 45 | 9 | 23 | 41 | 180 |
| | - | 100 | 30 | 8 | 19 | 45 | 177 |
| | - | 500 | 32 | 14 | 33 | 88 | 140 |
| | - | 1000* | 36 | 32 | 42 | 93 | 199 |
| | - | 2500* | 21 | 34 | 44 | 64 | 186 |
| | + | 10 | 12 | 7 | 30 | 54 | 212 |
| | + | 50 | 13 | 8 | 41 | 84 | 230 |
| | + | 100 | 5 | 10 | 48 | 172 | 274 |
| | + | 500 | 5 | 14 | 83 | 161 | 323 |
| | + | 1000* | 10 | 14 | 66 | 135 | 331 |
| | + | 2500* | 11 | 17 | 112 | 229 | 278 |

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* Formed precipitate when plated.

## Table 45

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{21}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 56,50 | 7,13 | 19,13 | 39,17 | 155,152 |
| | + | 50,000 | 20,18 | 21,17 | 21,48 | 41,33 | 131,138 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 501 | | | | |
| | - | 1.0 | | | | | 700 |
| 9-Aminoacridine | - | 50 | | 568 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1490 | 1101 | |
| 2-Anthramine | - | 1.0 | | | 14 | 45 | 137 |
| | + | 1.0 | | | 209 | 246 | 421 |
| | - | 2.5 | 44 | 19 | | | |
| | + | 2.5 | 493 | 435 | | | |
| $RO_{21}$ | - | 10 | 49 | 12 | 27 | 42 | 155 |
| | - | 50 | 44 | 14 | 36 | 44 | 165 |
| | - | 100 | 48 | 13 | 28 | 31 | 151 |
| | - | 500* | 57 | 17 | 24 | 36 | 132 |
| | - | 1000* | 44 | 7 | 22 | 30 | 151 |
| | - | 2500* | 45 | 13 | 22 | 28 | 130 |
| | + | 10 | 12 | 22 | 41 | 59 | 144 |
| | + | 50 | 26 | 31 | 54 | 69 | 170 |
| | + | 100 | 24 | 29 | 42 | 75 | 164 |
| | + | 500* | 20 | 28 | 59 | 68 | 196 |
| | + | 1000* | 12 | 28 | 66 | 79 | 256 |
| | + | 2500* | 19 | 31 | 61 | 70 | 157 |

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* Formed precipitate when plated.

## Table 46

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{21}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate TA1535 | TA1537 | TA1538 | TA98 | TA100 |
|---|---|---|---|---|---|---|---|
| Negative control (dioxane) | - | 50,000 | 41,38 | 9,13 | 8, 7 | 41,49 | 207,200 |
| | + | 50,000 | 8,16 | 3,14 | 20,17 | 38,40 | 213,176 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 387 | | | | |
| | - | 1.0 | | | | | 634 |
| 9-Aminoacridine | - | 50 | | 213 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 907 | 679 | |
| 2-Anthramine | + | 1.0 | | | 316 | 166 | 292 |
| | + | 2.5 | 142 | 51 | | | |
| $RO_{21}$ | - | 10 | 44 | 8 | 17 | 47 | 178 |
| | - | 50 | 52 | 15 | 22 | 40 | 187 |
| | - | 100* | 44 | 10 | 16 | 36 | 182 |
| | - | 500* | 39 | 12 | 11 | 37 | 131 |
| | - | 1000* | 43 | 5 | 16 | 39 | 161 |
| | - | 2500* | 47 | 8 | 12 | 15 | 172 |
| | + | 10 | 10 | 7 | 20 | 35 | 182 |
| | + | 50 | 16 | 11 | 23 | 48 | 180 |
| | + | 100* | 16 | 12 | 15 | 63 | 198 |
| | + | 500* | 10 | 3 | 30 | 69 | 206 |
| | + | 1000* | 12 | 8 | 31 | 77 | 198 |
| | + | 2500* | 11 | 13 | 35 | 56 | 198 |

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* Formed precipitate when plated.

## Table 47

## *IN VITRO* ASSAYS WITH *SALMONELLA TYPHIMURIUM*

## $RO_{21}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Average Histidine Revertants per Plate TA1538 | TA98 | TA100 |
|---|---|---|---|---|---|
| Negative control (dioxane) | + | 50,000 | 34,37 | 43,41 | 135,127 |
| Positive controls | | | | | |
| Sodium azide | - | 1.0 | | | 531 |
| 2-Nitrofluorene | - | 5.0 | 1394 | 262 | |
| 2-Anthramine | + | 1.0 | 169 | 184 | 266 |
| $RO_{21}$ | + | 10 | 36 | 43 | 161 |
| | + | 50 | 38 | 57 | 163 |
| | + | 100 | 38 | 62 | 177 |
| | + | 500* | 35 | 61 | 184 |
| | + | 1000* | 50 | 67 | 174 |
| | + | 2500* | 52 | 53 | 165 |

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* Formed precipitate when plated.

## Table 48

## *IN VITRO* ASSAYS WITH *SALMONELLA TYPHIMURIUM*

## $RO_{22}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 56,50 | 7,13 | 19,13 | 39,17 | 155,152 |
| | + | 50,000 | 20,18 | 21,17 | 21,48 | 41,33 | 131,138 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 501 | | | | |
| | - | 1.0 | | | | | 700 |
| 9-Aminoacridine | - | 50 | | 568 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1490 | 1101 | |
| 2-Anthramine | - | 1.0 | | | 14 | 45 | 137 |
| | + | 1.0 | | | 209 | 246 | 421 |
| | - | 2.5 | 44 | 19 | | | |
| | + | 2.5 | 493 | 435 | | | |
| $RO_{22}$ | - | 10 | 50 | 10 | 23 | 43 | 134 |
| | - | 50 | 45 | 9 | 25 | 33 | 127 |
| | - | 100* | 48 | 15 | 26 | 27 | 117 |
| | - | 500* | 49 | 13 | 24 | 39 | 128 |
| | - | 1000* | 39 | 11 | 14 | 37 | 128 |
| | - | 2500* | 57 | 12 | 15 | 41 | 136 |
| | + | 10 | 10 | 28 | 65 | 46 | 139 |
| | + | 50 | 21 | 20 | 88 | 74 | 176 |
| | + | 100* | 6 | 41 | 94 | 100 | 219 |
| | + | 500* | 20 | 33 | 119 | 140 | 249 |
| | + | 1000* | 14 | 30 | 141 | 159 | 199 |
| | + | 2500* | 20 | 31 | 155 | 165 | 203 |

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* Formed precipitate when plated.

## Table 49

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{22}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 9,13 | 8, 7 | 41,49 | 207,200 |
| | + | 50,000 | 8,16 | 3,14 | 20,17 | 38,40 | 213,176 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 387 | | | | |
| | - | 1.0 | | | | | 634 |
| 9-Aminoacridine | - | 50 | | 213 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 907 | 679 | |
| 2-Anthramine | + | 1.0 | | | 316 | 166 | 292 |
| | + | 2.5 | 142 | 51 | | | |
| $RO_{22}$ | - | 10 | 46 | 7 | 16 | 35 | 165 |
| | - | 50 | 41 | 6 | 16 | 35 | 168 |
| | - | 100* | 33 | 7 | 17 | 46 | 175 |
| | - | 500* | 40 | 6 | 17 | 46 | 187 |
| | - | 1000* | 32 | 3 | 19 | 34 | 163 |
| | - | 2500* | 41 | 5 | 13 | 24 | 123 |
| | + | 10 | 15 | 14 | 29 | 48 | 207 |
| | + | 50 | 7 | 16 | 42 | 70 | 223 |
| | + | 100* | 14 | 13 | 47 | 81 | 236 |
| | + | 500* | 12 | 18 | 66 | 118 | 243 |
| | + | 1000* | 11 | 18 | 75 | 113 | 238 |
| | + | 2500* | 11 | 18 | 101 | 126 | 236 |

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* Formed precipitate when plated.

## Table 50

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{23}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate TA1535 | TA1537 | TA1538 | TA98 | TA100 |
|---|---|---|---|---|---|---|---|
| Negative control (dioxane) | - | 50,000 | 56,50 | 7,13 | 19,13 | 39,17 | 155,152 |
| | + | 50,000 | 20,18 | 21,17 | 21,48 | 41,33 | 131,138 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 501 | | | | |
| | - | 1.0 | | | | | 700 |
| 9-Aminoacridine | - | 50 | | 568 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1490 | 1101 | |
| 2-Anthramine | - | 1.0 | | | 14 | 45 | 137 |
| | + | 1.0 | | | 209 | 246 | 421 |
| | - | 2.5 | 44 | 19 | | | |
| | + | 2.5 | 493 | 435 | | | |
| $RO_{23}$ | - | 10 | 39 | 15 | 39 | 39 | 136 |
| | - | 50 | 38 | 12 | 29 | 29 | 136 |
| | - | 100* | 60 | 15 | 48 | 29 | 114 |
| | - | 500* | 62 | 9 | 15 | 36 | 112 |
| | - | 1000* | 43 | 10 | 24 | 22 | 109 |
| | - | 2500* | 45 | 10 | 26 | 28 | 109 |
| | + | 10 | 21 | 23 | 52 | 65 | 158 |
| | + | 50 | 19 | 33 | 84 | 78 | 189 |
| | + | 100* | 15 | 27 | 88 | 100 | 197 |
| | + | 500* | 17 | 43 | 126 | 148 | 212 |
| | + | 1000* | 17 | 32 | 159 | 188 | 183 |
| | + | 2500* | 12 | 40 | 171 | 213 | 141 |

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* Formed precipitate when plated.

Table 51

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

$RO_{23}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate TA1535 | TA1537 | TA1538 | TA98 | TA100 |
|---|---|---|---|---|---|---|---|
| Negative control (dioxane) | - | 50,000 | 41,38 | 9,13 | 8, 7 | 41,49 | 207,200 |
|  | + | 50,000 | 8,16 | 3,14 | 20,17 | 38,40 | 213,176 |
| Positive controls |  |  |  |  |  |  |  |
| Sodium azide | - | 0.5 | 387 |  |  |  |  |
|  | - | 1.0 |  |  |  |  | 634 |
| 9-Aminoacridine | - | 50 |  | 213 |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  | 907 | 679 |  |
| 2-Anthramine | + | 1.0 |  |  | 316 | 166 | 292 |
|  | + | 2.5 | 142 | 51 |  |  |  |
| $RO_{23}$ | - | 10 | 45 | 9 | 18 | 55 | 220 |
|  | - | 50 | 46 | 4 | 12 | 50 | 198 |
|  | - | 100* | 41 | 7 | 11 | 36 | 192 |
|  | - | 500* | 46 | 4 | 5 | 38 | 192 |
|  | - | 1000* | 24 | 7 | 16 | 34 | 134 |
|  | - | 2500* | 40 | 11 | 8 | 18 | 150 |
|  | + | 10 | 15 | 9 | 26 | 45 | 280 |
|  | + | 50 | 9 | 11 | 47 | 106 | 281 |
|  | + | 100* | 15 | 13 | 47 | 94 | 265 |
|  | + | 500* | 6 | 13 | 87 | 148 | 276 |
|  | + | 1000* | 8 | 14 | 98 | 147 | 245 |
|  | + | 2500* | 13 | 10 | 123 | 158 | 232 |

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* Formed precipitate when plated.

## Table 52

## *IN VITRO* ASSAYS WITH *SALMONELLA TYPHIMURIUM*

## $RO_{24}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine REvertants per Plate TA1535 | TA1537 | TA1538 | TA98 | TA100 |
|---|---|---|---|---|---|---|---|
| Negative control (dioxane) | - | 50,000 | 56,50 | 7,13 | 19,13 | 39,17 | 155,152 |
| | + | 50,000 | 20,18 | 21,17 | 21,48 | 41,33 | 131,138 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 501 | | | | |
| | - | 1.0 | | | | | 700 |
| 9-Aminoacridine | - | 50 | | 568 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1490 | 1101 | |
| 2-Anthramine | - | 1.0 | | | 14 | 45 | 137 |
| | + | 1.0 | | | 209 | 246 | 421 |
| | - | 2.5 | 44 | 19 | | | |
| | + | 2.5 | 493 | 435 | | | |
| $RO_{24}$ | - | 10 | 37 | 9 | 46 | 24 | 150 |
| | - | 50 | 34 | 13 | 26 | 54 | 151 |
| | - | 100* | 40 | 10 | 36 | 51 | 162 |
| | - | 500* | 50 | 8 | 44 | 71 | 233 |
| | - | 1000* | 41 | 16 | 33 | 74 | 202 |
| | - | 2500* | 27 | 20 | 23 | 106 | 187 |
| | + | 10 | 18 | 28 | 86 | 96 | 181 |
| | + | 50 | 12 | 39 | 161 | 191 | 335 |
| | + | 100* | 9 | 47 | 192 | 227 | 361 |
| | + | 500* | 12 | 60 | 247 | 298 | 483 |
| | + | 1000* | 17 | 71 | 271 | 369 | 417 |
| | + | 2500* | 9 | 65 | 361 | 401 | 391 |

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* Formed precipitate when plated.

## Table 53

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{24}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 9,13 | 8, 7 | 41,49 | 207,200 |
| | + | 50,000 | 8,16 | 3,14 | 20,17 | 38,40 | 213,176 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 387 | | | | |
| | - | 1.0 | | | | | 634 |
| 9-Aminoacridine | - | 50 | | 213 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 907 | 679 | |
| 2-Anthramine | + | 1.0 | | | 316 | 166 | 292 |
| | + | 2.5 | 142 | 51 | | | |
| $RO_{24}$ | - | 10 | 38 | 12 | 31 | 59 | 214 |
| | - | 50 | 46 | 11 | 48 | 97 | 241 |
| | - | 100 | 48 | 10 | 52 | 150 | 241 |
| | - | 500* | 44 | 8 | 40 | 170 | 259 |
| | - | 1000* | 48 | 13 | 33 | 139 | 245 |
| | - | 2500* | 36 | 20 | 72 | 169 | 252 |
| | + | 10 | 14 | 15 | 57 | 92 | 306 |
| | + | 50 | 9 | 11 | 78 | 221 | 390 |
| | + | 100 | 7 | 17 | 114 | 254 | 434 |
| | + | 500* | 10 | 26 | 158 | 342 | 519 |
| | + | 1000* | 10 | 30 | 365 | 373 | 381 |
| | + | 2500* | 12 | 27 | 108 | 401 | 241 |

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* Formed precipitate when plated.

## Table 54

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{25}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 56,50 | 7,13 | 19,13 | 39,17 | 155,152 |
| | + | 50,000 | 20,18 | 21,17 | 21,48 | 41,33 | 131,138 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 501 | | | | |
| | - | 1.0 | | | | | 700 |
| 9-Aminoacridine | - | 50 | | 568 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1490 | 1101 | |
| 2-Anthramine | - | 1.0 | | | 14 | 45 | 137 |
| | + | 1.0 | | | 209 | 246 | 421 |
| | - | 2.5 | 44 | 19 | | | |
| | + | 2.5 | 493 | 435 | | | |
| $RO_{25}$ | - | 10 | 42 | 9 | 13 | 23 | 131 |
| | - | 50 | 44 | 10 | 13 | 24 | 147 |
| | - | 100* | 45 | 7 | 18 | 28 | 153 |
| | - | 500* | 47 | 8 | 21 | 33 | 155 |
| | - | 1000* | 44 | 15 | 25 | 23 | 158 |
| | - | 2500* | 40 | 11 | 22 | 32 | 163 |
| | + | 10 | 23 | 18 | 42 | 42 | 167 |
| | + | 50 | 15 | 15 | 31 | 50 | 187 |
| | + | 100* | 21 | 31 | 54 | 53 | 204 |
| | + | 500* | 15 | 31 | 64 | 93 | 242 |
| | + | 1000* | 19 | 25 | 85 | 76 | 281 |
| | + | 2500* | 12 | 33 | 86 | 83 | 242 |

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* Formed precipitate when plated.

## Table 55

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## RO$_{25}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 9,13 | 8, 7 | 41,49 | 207,200 |
| | + | 50,000 | 8,16 | 3,14 | 20,17 | 38,40 | 213,176 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 387 | | | | |
| | - | 1.0 | | | | | 634 |
| 9-Aminoacridine | - | 50 | | 213 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 907 | 679 | |
| 2-Anthramine | + | 1.0 | | | 316 | 166 | 292 |
| | + | 2.5 | 142 | 51 | | | |
| RO$_{25}$ | - | 10 | 41 | 4 | 12 | 23 | 181 |
| | - | 50 | 41 | 10 | 15 | 34 | 174 |
| | - | 100* | 40 | 5 | 18 | 38 | 200 |
| | - | 500* | 49 | 5 | 24 | 43 | 191 |
| | - | 1000* | 41 | 8 | 30 | 43 | 176 |
| | - | 2500* | 34 | 12 | 17 | 33 | 184 |
| | + | 10 | 10 | 6 | 26 | 39 | 172 |
| | + | 50 | 19 | 7 | 26 | 61 | 195 |
| | + | 100* | 15 | 13 | 47 | 63 | 223 |
| | + | 500* | 9 | 15 | 45 | 75 | 292 |
| | + | 1000* | 11 | 12 | 57 | 99 | 302 |
| | + | 2500* | 13 | 16 | 63 | 80 | 249 |

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* Formed precipitate when plated.

## Table 56

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{26}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 56,50 | 7,13 | 19,13 | 39,17 | 155,152 |
| | + | 50,000 | 20,18 | 21,17 | 21,48 | 41,33 | 131,138 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 501 | | | | |
| | - | 1.0 | | | | | 700 |
| 9-Aminoacridine | - | 50 | | 568 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 1490 | 1101 | |
| 2-Anthramine | - | 1.0 | | | 14 | 45 | 137 |
| | + | 1.0 | | | 209 | 246 | 421 |
| | - | 2.5 | 44 | 19 | | | |
| | + | 2.5 | 493 | 435 | | | |
| $RO_{26}$ | - | 10 | 45 | 10 | 11 | 22 | 157 |
| | - | 50 | 42 | 16 | 14 | 17 | 138 |
| | - | 100 | 49 | 12 | 10 | 23 | 145 |
| | - | 500* | 46 | 18 | 16 | 15 | 153 |
| | - | 1000* | 40 | 15 | 24 | 24 | 158 |
| | - | 2500* | 42 | 10 | 19 | 24 | 171 |
| | + | 10 | 23 | 29 | 35 | 28 | 158 |
| | + | 50 | 15 | 22 | 37 | 39 | 226 |
| | + | 100 | 21 | 26 | 48 | 56 | 231 |
| | + | 500* | 23 | 20 | 78 | 74 | 309 |
| | + | 1000* | 21 | 24 | 70 | 90 | 321 |
| | + | 2500* | 20 | 27 | 65 | 89 | 245 |

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* Formed precipitate when plated.

## Table 57

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_{26}$

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 50,000 | 41,38 | 9,13 | 8, 7 | 41,49 | 207,200 |
| | + | 50,000 | 8,16 | 3,14 | 20,17 | 38,40 | 213,176 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 387 | | | | |
| | - | 1.0 | | | | | 634 |
| 9-Aminoacridine | - | 50 | | 213 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 907 | 679 | |
| 2-Anthramine | + | 1.0 | | | 316 | 166 | 292 |
| | + | 2.5 | 142 | 51 | | | |
| $RO_{26}$ | - | 10 | 37 | 3 | 18 | 43 | 194 |
| | - | 50 | 46 | 12 | 16 | 38 | 209 |
| | - | 100* | 35 | 10 | 16 | 34 | 219 |
| | - | 500* | 40 | 15 | 19 | 40 | 219 |
| | - | 1000* | 52 | 8 | 20 | 43 | 190 |
| | - | 2500* | 57 | 10 | 15 | 32 | 174 |
| | + | 10 | 10 | 12 | 23 | 35 | 183 |
| | + | 50 | 11 | 16 | 32 | 62 | 223 |
| | + | 100* | 9 | 10 | 25 | 74 | 229 |
| | + | 500* | 9 | 28 | 34 | 85 | 237 |
| | + | 1000* | 6 | 19 | 44 | 81 | 244 |
| | + | 2500* | 9 | 11 | 45 | 80 | 216 |

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* Formed precipitate when plated.

SRI International

# IN VITRO MICROBIOLOGICAL MUTAGENICITY ASSAYS OF WESTINGHOUSE ELECTRIC CORPORATION SAMPLES $RO_3$-1 THROUGH $RO_3$-9

Final Report

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# SUMMARY

SRI International examined Westinghouse samples $RO_3$-1 through $RO_3$-9 for mutagenic activity with strains TA1535, TA1537, TA1538, TA98, and TA100 of *Salmonella typhimurium* in the standard Ames *Salmonella*/microsome assay. Each assay was performed in the presence and in the absence of a rat liver metabolic activation system. Weak mutagenic activity was observed in assays performed on samples $RO_3$-3, $RO_3$-4, and $RO_3$-5 only in the presence of metabolic activation. No mutagenic activity was observed in any of the tests conducted on samples $RO_3$-1, $RO_3$-2, $RO_3$-6, $RO_3$-7, $RO_3$-8, and $RO_3$-9.

# INTRODUCTION

SRI International examined Westinghouse samples $RO_3$-1 through $RO_3$-9 for mutagenicity by *in vitro* microbiological assays with strains TA1535, TA1537, TA1538, TA98, and TA100 of the bacterium *Salmonella typhimurium* in the standard Ames *Salmonella*/microsome assay. An Aroclor 1254-stimulated, rat liver homogenate metabolic activation system was included in the assay procedure to provide metabolic steps that the bacteria either are incapable of conducting or do not carry out under the assay conditions. The solvent used for all dilutions was dioxane supplied by Westinghouse.

The assay procedure with *S. typhimurium* has proven to be 80 to 90% reliable in detecting carcinogens as mutagens, and it has about the same reliability in identifying chemicals that are not carcinogenic.[1] However, because this test system does not always provide 100% correlation with carcinogenicity investigations in animals, neither a positive nor a negative response conclusively proves that a chemical is hazardous or nonhazardous to man.

## RESULTS AND DISCUSSION

Tables 1 through 14 present the results of the microbiological assays conducted on Westinghouse samples $RO_3$-1 through $RO_3$-9. The samples were tested over a wide range of concentrations, from 5 to 5000 μg/plate. Many of the samples formed precipitates in the top agar when plated (indicated by "ppt" on the individual tables).

No Toxicity or mutagenicity was observed in either of the experiments performed on $RO_3$-1 (Tables 1 and 2).

In experiments conducted on sample $RO_3$-2 (Tables 3 and 4), no mutagenic activity was observed. This compound was toxic in *S. typhimurium* strain TA1535 at the dose of 5000 μg/plate in the presence of metabolic activation. Precipitation was observed at doses of 1000 μg/plate and higher.

In the initial experiment on Sample $RO_3$-3 (Table 5), elevated numbers of revertants were observed in strains TA1537, TA1538, TA98, and TA100 in the presence of metabolic activation. These results were confirmed in the second experiment (Table 6) in strains TA1538, TA98, and TA100 in the presence of metabolic activation. In this second experiment, there were irregular--but slight--dose-related increases in the number of revertants in these strains. Due to the limited amount of sample supplied, we were unable to further investigate this mutagenic activity. We conclude that this compound may be weakly mutagenic.

Because of the limited amount of sample provided, only one assay was performed on $RO_3$-4 (Table 7). This compound caused dose-related increases in the number of histidine-independent revertants in strains TA1537, TA1538, TA98, and TA100 in the presence of metabolic activation. However, without performing a second assay to establish reproducibility, we cannot call $RO_3$-4 conclusively positive or negative. In this initial experiment, however, it did appear to demonstrate mutagenic activity.

Results for experiments conducted on sample $RO_3$-5 are presented in Tables 8 through 10. In the first assay (Table 8), very slight increases in the number of histidine-independent revertants were observed at the higher doses in strains TA1537, TA1538, TA98, and TA100 in the presence of metabolic activation. In the second and third experiments (Tables 9 and 10, respectively), slight--but irregular--dose-related increases in mutagenic activity were observed in strains TA1538, TA98, and TA100 in the presence of metabolic activation. We conclude that this compound is weakly mutagenic.

Results for experiments performed on samples $RO_3$-6, $RO_3$-7, $RO_3$-8, and $RO_3$-9 are shown in Tables 11, 12, 13, and 14, respectively. No significant mutagenic activity was observed in any of these tests. Due to the limited amount of sample supplied, we could complete only a single assay on each of these samples. Therefore, it is difficult to draw any conclusions concerning their mutagenic potential; however, initial tests showed no mutagenic activity or toxicity.

In summary, samples $RO_3$-3, $RO_3$-4, and $RO_3$-5 demonstrated slight--but weak--mutagenic responses, primarily in S. typhimurium strains TA1538,TA98, and TA100 and only in the presence of metabolic activation. No mutagenic activity was observed with the other six samples.

## Table 1

## *IN VITRO* ASSAYS WITH *SALMONELLA TYPHIMURIUM*

### $RO_5$-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 100,000 | 42,30 | 18,14 | 16,13 | 31,27 | 76,111 |
| | + | 100,000 | 13,17 | 16,25 | 21,19 | 39,33 | 117,111 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 313 | | | | |
| | - | 1.0 | | | | | 421 |
| 9-Aminoacridine | - | 50.0 | | 611 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 891 | 976 | |
| 2-Anthramine | - | 1.0 | | | 19 | 24 | 131 |
| | + | 1.0 | | | 206 | 188 | 345 |
| | - | 2.5 | 44 | 13 | | | |
| | + | 2.5 | 309 | 134 | | | |
| $RO_5$-1 | - | 50 | 30 | 14 | 9 | 36 | 126 |
| | - | 100 | 38 | 13 | 15 | 30 | 105 |
| | - | 500 | 40 | 15 | 19 | 36 | 131 |
| | - | 1000 | 45 | 16 | 18 | 28 | 139 |
| | - | 2500 | 37 | 14 | 12 | 20 | 127 |
| | - | 5000 | 29 | 13 | 13 | 29 | 112 |
| | + | 50 | 17 | 20 | 30 | 49 | 136 |
| | + | 100 | 27 | 21 | 36 | 29 | 149 |
| | + | 500 | 26 | 20 | 27 | 33 | 123 |
| | + | 1000 | 28 | 26 | 19 | 40 | 124 |
| | + | 2500 | 18 | 25 | 25 | 41 | 111 |
| | + | 5000 | 30 | 20 | 18 | 48 | 130 |

Table 2

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO$_3$-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 100,000 | 37,37 | 17, 6 | 15, 7 | 29,33 | 127,122 |
| | + | 100,000 | 8,19 | 8,14 | 17,26 | 42,49 | 126,111 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 356 | | | | |
| | - | 1.0 | | | | | 537 |
| 9-Aminoacridine | - | 50.0 | | 506 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 872 | 489 | |
| 2-Anthramine | - | 1.0 | | | 14 | 30 | 120 |
| | + | 1.0 | | | 236 | 262 | 239 |
| | - | 2.5 | 28 | 9 | | | |
| | + | 2.5 | 86 | 49 | | | |
| RO$_3$-1 | - | 50 | 21 | 7 | 18 | 30 | 100 |
| | - | 100 | 13 | 7 | 12 | 27 | 104 |
| | - | 500 | 21 | 7 | 12 | 30 | 99 |
| | - | 1000 | 28 | 12 | 11 | 19 | 111 |
| | - | 2500 | 21 | 7 | 10 | 20 | 97 |
| | - | 5000 | 21 | 6 | 16 | 25 | 92 |
| | + | 50 | 8 | 14 | 16 | 20 | 102 |
| | + | 100 | 8 | 11 | 28 | 26 | 104 |
| | + | 500 | 11 | 10 | 20 | 26 | 81 |
| | + | 1000 | 7 | 9 | 16 | 24 | 108 |
| | + | 2500 | 6 | 11 | 31 | 21 | 108 |
| | + | 5000 | 7 | 8 | 28 | 19 | 81 |

## Table 3

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## RO$_3$- 2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 100,000 | 42,30 | 18,14 | 16,13 | 31,27 | 76,111 |
| | + | 100,000 | 13,17 | 16,25 | 21,19 | 39,33 | 117,111 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 313 | | | | |
| | - | 1.0 | | | | | 421 |
| 9-Aminoacridine | - | 50.0 | | 611 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 841 | 976 | |
| 2-Anthramine | - | 1.0 | | | 19 | 24 | 131 |
| | + | 1.0 | | | 206 | 188 | 345 |
| | - | 2.5 | 44 | 13 | | | |
| | + | 2.5 | 309 | 134 | | | |
| RO$_3$-2 | - | 50 | 41 | 15 | 13 | 33 | 139 |
| | - | 100 | 37 | 11 | 16 | 30 | 146 |
| | - | 500 | 37 | 8 | 20 | 28 | 171 |
| | - | 1000ppt* | 48 | 12 | 30 | 31 | 131 |
| | - | 2500ppt | 37 | 18 | 19 | 33 | 130 |
| | - | 5000ppt | 38 | 9 | 21 | 24 | 110 |
| | + | 50 | 18 | 17 | 27 | 26 | 128 |
| | + | 100 | 17 | 6 | 17 | 40 | 147 |
| | + | 500 | 26 | 18 | 33 | 30 | 130 |
| | + | 1000ppt | 24 | 20 | 18 | 36 | 134 |
| | + | 2500ppt | 22 | 27 | 15 | 41 | 129 |
| | + | 5000ppt | T† | 11 | 20 | 29 | 116 |

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* Formed precipitate when plated.

† T, toxic.

Table 4

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

$RO_3$-2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 100,000 | 37,37 | 17, 6 | 15, 7 | 29,33 | 127,122 |
| | + | 100,000 | 8,19 | 8,14 | 17,26 | 42,49 | 126,111 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 356 | | | | |
| | - | 1.0 | | | | | 537 |
| 9-Aminoacridine | - | 50.0 | | 506 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 872 | 489 | |
| 2-Anthramine | - | 1.0 | | | 14 | 30 | 120 |
| | + | 1.0 | | | 236 | 262 | 239 |
| $RO_3$-2 | - | 50 | 20 | 15 | 9 | 25 | 98 |
| | - | 100 | 21 | 12 | 12 | 21 | 96 |
| | - | 500 | 30 | 9 | 9 | 28 | 109 |
| | - | 1000ppt* | 31 | 10 | 14 | 21 | 101 |
| | - | 2500ppt | 28 | 9 | 12 | 24 | 124 |
| | - | 5000ppt | 28 | 7 | 10 | 15 | 104 |
| | + | 50 | 13 | 12 | 20 | 20 | 104 |
| | + | 100 | 9 | 11 | 19 | 30 | 129 |
| | + | 500 | 7 | 19 | 36 | 37 | 139 |
| | + | 1000ppt | 12 | 12 | 26 | 37 | 125 |
| | + | 2500ppt | 11 | 21 | 25 | 37 | 154 |
| | + | 5000ppt | 8 | 8 | 30 | 34 | 150 |

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* Formed precipitate when plated.

## Table 5

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_3$-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 100,000 | 42,30 | 18,14 | 16,13 | 31,27 | 76,111 |
| | + | 100,000 | 13,17 | 16,25 | 21,19 | 39,33 | 117,111 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 313 | | | | |
| | - | 1.0 | | | | | 421 |
| 9-Aminoacridine | - | 50.0 | | 611 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 891 | 976 | |
| 2-Anthramine | - | 1.0 | | | 19 | 24 | 131 |
| | + | 1.0 | | | 206 | 188 | 345 |
| | - | 2.5 | 44 | 13 | | | |
| | + | 2.5 | 309 | 134 | | | |
| $RO_3$-3 | - | 50 | 33 | 4 | 19 | 18 | 114 |
| | - | 100ppt* | 31 | 12 | 12 | 30 | 117 |
| | - | 500ppt | 39 | 14 | 15 | 18 | 152 |
| | - | 1000ppt | 31 | 14 | 14 | 28 | 149 |
| | - | 2500ppt | 28 | 11 | 13 | 40 | 152 |
| | - | 5000ppt | 38 | 15 | 20 | 29 | 139 |
| | + | 50 | 20 | 31 | 26 | 37 | 163 |
| | + | 100ppt | 18 | 23 | 28 | 48 | 178 |
| | + | 500ppt | 24 | 22 | 24 | 45 | 189 |
| | + | 1000ppt | 19 | 37 | 41 | 60 | 192 |
| | + | 2500ppt | 17 | 28 | 34 | 48 | 180 |
| | + | 5000ppt | 13 | 27 | 31 | 46 | 179 |

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* Formed precipitate when plated.

## Table 6

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_3$-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 100,000 | 37,37 | 17, 6 | 15, 7 | 29,33 | 127,122 |
| | + | 100,000 | 8,19 | 8,14 | 17,26 | 42,49 | 126,111 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 356 | | | | |
| | - | 1.0 | | | | | 537 |
| 9-Aminoacridine | - | 50.0 | | 506 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 872 | 489 | |
| 2-Anthramine | - | 1.0 | | | 14 | 30 | 120 |
| | + | 1.0 | | | 236 | 262 | 239 |
| | - | 2.5 | 28 | 9 | | | |
| | + | 2.5 | 86 | 49 | | | |
| $RO_3$-3 | - | 50ppt* | 22 | 4 | 22 | 20 | 159 |
| | - | 100ppt | 21 | 8 | 11 | 27 | 158 |
| | - | 500ppt | 35 | 10 | 25 | 55 | 155 |
| | - | 1000ppt | 33 | 16 | 24 | 44 | 154 |
| | - | 2500ppt | 32 | 4 | 18 | 31 | 151 |
| | - | 5000ppt | 24 | 9 | 27 | 38 | 161 |
| | + | 50ppt | 10 | 22 | 37 | 51 | 181 |
| | + | 100ppt | 12 | 18 | 30 | 52 | 210 |
| | + | 500ppt | 15 | 18 | 39 | 74 | 274 |
| | + | 1000ppt | 15 | 18 | 59 | 70 | 245 |
| | + | 2500ppt | 10 | 18 | 68 | 82 | 232 |
| | + | 5000ppt | 8 | 14 | 44 | 70 | 203 |

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* Formed precipitate when plated.

Table 7

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO$_3$-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 100,000 | 37,37 | 17, 6 | 15, 7 | 29,33 | 127,122 |
| | + | 100,000 | 8,19 | 8,14 | 17,26 | 42,49 | 126,111 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 356 | | | | |
| | - | 1.0 | | | | | 537 |
| 9-Aminoacridine | - | 50.0 | | 506 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 872 | 489 | |
| 2-Anthramine | - | 1.0 | | | 14 | 30 | 120 |
| | + | 1.0 | | | 236 | 262 | 239 |
| | - | 2.5 | 28 | 9 | | | |
| | + | 2.5 | 86 | 49 | | | |
| RO$_3$-4 | - | 10ppt* | 16 | 6 | 14 | 29 | 158 |
| | - | 50ppt | 18 | 11 | 13 | 40 | 168 |
| | - | 100ppt | 20 | 12 | 13 | 37 | 167 |
| | - | 500ppt | 21 | 12 | 24 | 34 | 154 |
| | - | 625ppt | 14 | 11 | 22 | 22 | 145 |
| | - | 1250ppt | 28 | 12 | 35 | 27 | 164 |
| | + | 10ppt | 12 | 10 | 29 | 39 | 139 |
| | + | 50ppt | 12 | 16 | 35 | 35 | 197 |
| | + | 100ppt | 18 | 22 | 31 | 64 | 234 |
| | + | 500ppt | 18 | 17 | 47 | 69 | 241 |
| | + | 625ppt | 20 | 24 | 44 | 72 | 247 |
| | + | 1250ppt | 19 | 24 | 41 | 76 | 201 |

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* Formed a precipitate when plated.

## Table 8

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_3$-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 100,000 | 42,30 | 18,14 | 16,13 | 31,27 | 76,111 |
| | + | 100,000 | 13,17 | 16,25 | 21,19 | 39,33 | 117,111 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 313 | | | | |
| | - | 1.0 | | | | | 421 |
| 9-Aminoacridine | - | 50.0 | | 611 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 891 | 976 | |
| 2-Anthramine | - | 1.0 | | | 19 | 24 | 131 |
| | + | 1.0 | | | 206 | 188 | 345 |
| | - | 2.5 | 44 | 13 | | | |
| | + | 2.5 | 309 | 134 | | | |
| $RO_3$-5 | - | 50 | 26 | 12 | 13 | 30 | 103 |
| | - | 100ppt* | 30 | 11 | 17 | 22 | 113 |
| | - | 500ppt | 32 | 9 | 9 | 27 | 108 |
| | - | 1000ppt | 38 | 9 | 12 | 29 | 119 |
| | - | 2500ppt | 42 | 8 | 19 | 33 | 117 |
| | - | 5000ppt | 26 | 7 | 22 | 35 | 131 |
| | + | 50 | 12 | 27 | 15 | 38 | 139 |
| | + | 100 | 19 | 29 | 35 | 35 | 146 |
| | + | 500 | 19 | 25 | 32 | 43 | 131 |
| | + | 1000 | 17 | 35 | 31 | 52 | 128 |
| | + | 2500 | 21 | 30 | 31 | 47 | 133 |
| | + | 5000 | 22 | 27 | 24 | 43 | 143 |

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* Formed precipitate when plated.

## Table 9

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_3$-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 100,000 | 37,37 | 17, 6 | 15, 7 | 29,33 | 127,122 |
| | + | 100,000 | 8,19 | 8,14 | 17,26 | 42,49 | 126,111 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 356 | | | | |
| | - | 1.0 | | | | | 537 |
| 9-Aminoacridine | - | 50.0 | | 506 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 872 | 489 | |
| 2-Anthramine | - | 1.0 | | | 14 | 30 | 120 |
| | + | 1.0 | | | 236 | 262 | 239 |
| | - | 2.5 | 28 | 9 | | | |
| | + | 2.5 | 86 | 49 | | | |
| $RO_3$-5 | - | 50ppt* | 40 | 11 | 14 | 23 | 127 |
| | - | 100ppt | 34 | 7 | 23 | 31 | 150 |
| | - | 500ppt | 36 | 17 | 13 | 37 | 117 |
| | - | 1000ppt | 35 | 15 | 24 | 29 | 149 |
| | - | 2500ppt | 47 | 6 | 12 | 18 | 122 |
| | - | 5000ppt | 41 | 9 | 12 | 23 | 124 |
| | + | 50ppt | 20 | 10 | 24 | 36 | 131 |
| | + | 100ppt | 12 | 12 | 20 | 32 | 130 |
| | + | 500ppt | 11 | 12 | 23 | 36 | 121 |
| | + | 1000ppt | 8 | 15 | 35 | 52 | 186 |
| | + | 2500ppt | 8 | 19 | 47 | 59 | 152 |
| | + | 5000ppt | 7 | 14 | 47 | 48 | 199 |

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* Formed precipitate when plated.

Table 10

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

$RO_3$-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | |
|---|---|---|---|---|---|
| | | | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | | 14,21 | 28,24 | 151,124 |
| | + | | 31,16 | 32,44 | 125,139 |
| Positive controls | | | | | |
| Sodium azide | - | 0.5 | | | 919 |
| 2-Nitrofluorene | - | 5.0 | 1867 | 1373 | |
| 2-Anthramine | + | 1.0 | 433 | 419 | 715 |
| $RO_3$-5 | - | 50ppt* | 17 | 33 | 163 |
| | - | 100ppt | 18 | 49 | 174 |
| | - | 500ppt | 19 | 38 | 192 |
| | - | 1000ppt | 15 | 33 | 180 |
| | - | 2500ppt | 21 | 41 | 168 |
| | - | 5000ppt | 26 | 56 | 172 |
| | + | 50ppt | 40 | 47 | 143 |
| | + | 100ppt | 44 | 46 | 173 |
| | + | 500ppt | 35 | 86 | 224 |
| | + | 1000ppt | 47 | 76 | 272 |
| | + | 2500ppt | 54 | 98 | 229 |
| | + | 5000ppt | 43 | 68 | 206 |

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* Formed precipitate when plated.

## Table 11

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
## $RO_3$-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 100,000 | 37,37 | 17, 6 | 15, 7 | 29,33 | 127,122 |
| | + | 100,000 | 8,19 | 8,14 | 17,26 | 42,49 | 126,111 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 356 | | | | |
| | - | 1.0 | | | | | 537 |
| 9-Aminoacridine | - | 50.0 | | 506 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 872 | 489 | |
| 2-Anthramine | - | 1.0 | | | 14 | 30 | 120 |
| | + | 1.0 | | | 236 | 262 | 239 |
| | - | 2.5 | 28 | 9 | | | |
| | + | 2.5 | 86 | 49 | | | |
| $RO_3$-6 | - | 10 | 24 | 8 | 14 | 26 | 109 |
| | - | 50 | 18 | 7 | 12 | 21 | 131 |
| | - | 100 | 28 | 13 | 8 | 21 | 129 |
| | - | 500 | 27 | 8 | 10 | 27 | 108 |
| | - | 1250 | 38 | 9 | 15 | 26 | 112 |
| | - | 2500 | 21 | 6 | 14 | 20 | 125 |
| | + | 10 | 7 | 12 | 12 | 42 | 135 |
| | + | 50 | 9 | 14 | 21 | 43 | 137 |
| | + | 100 | 17 | 14 | 20 | 40 | 166 |
| | + | 500 | 23 | 10 | 32 | 50 | 160 |
| | + | 1250 | 17 | 10 | 24 | 42 | 164 |
| | + | 2500 | 20 | 9 | 29 | 40 | 171 |

## Table 12

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## RO$_3$-7

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 100,000 | 37,37 | 17, 6 | 15, 7 | 29,33 | 127,122 |
| | + | 100,000 | 8,19 | 8,14 | 17,26 | 42,49 | 126,111 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 356 | | | | |
| | - | 1.0 | | | | | 537 |
| 9-Aminoacridine | - | 50.0 | | 506 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 872 | 489 | |
| 2-Anthramine | - | 1.0 | | | 14 | 30 | 120 |
| | + | 1.0 | | | 236 | 262 | 239 |
| | - | 2.5 | 28 | 9 | | | |
| | + | 2.5 | 86 | 49 | | | |
| RO$_3$-7 | - | 10 | 24 | 7 | 12 | 25 | 123 |
| | - | 50 | 32 | 6 | 15 | 25 | 127 |
| | - | 100ppt* | 21 | 8 | 13 | 25 | 125 |
| | - | 500ppt | 26 | 6 | 10 | 24 | 119 |
| | - | 1250ppt | 24 | 8 | 8 | 14 | 116 |
| | - | 2500ppt | 20 | 6 | 11 | 14 | 108 |
| | + | 10 | 14 | 11 | 18 | 29 | 139 |
| | + | 50 | 20 | 10 | 30 | 31 | 142 |
| | + | 100ppt | 17 | 15 | 22 | 31 | 147 |
| | + | 500ppt | 32 | 15 | 23 | 38 | 155 |
| | + | 1250ppt | 15 | 18 | 27 | 50 | 142 |
| | + | 2500ppt | 19 | 16 | 30 | 61 | 149 |

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* Formed precipitate when plated.

## Table 13

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_5$-8

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate TA1535 | TA1537 | TA1538 | TA98 | TA100 |
|---|---|---|---|---|---|---|---|
| Negative control (dioxane) | - | 100,000 | 72,53 | 28,17 | 10,11 | 32,30 | 150,141 |
| | + | 100,000 | 20,16 | 52,45 | 24,25 | 41,37 | 153,162 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 411 | | | | 660 |
| 9-Aminoacridne | - | 50.0 | | 161 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 736 | 475 | |
| 2-Anthramine | - | 1.0 | | | 27 | 26 | 123 |
| | + | 1.0 | | | 251 | 197 | 318 |
| | - | 2.5 | 57 | 28 | | | |
| | + | 2.5 | 147 | 92 | | | |
| $RO_5$-8 | - | 5 | 35 | 38 | 13 | 36 | 129 |
| | - | 10 | 41 | 24 | 20 | 38 | 130 |
| | - | 50ppt* | 41 | 26 | 19 | 43 | 165 |
| | - | 100ppt | 35 | 24 | 20 | 42 | 139 |
| | - | 500ppt | 40 | 28 | 21 | 36 | 154 |
| | - | 1000ppt | 52 | 35 | 21 | 45 | 175 |
| | + | 5 | 24 | 38 | 34 | 59 | 155 |
| | + | 10 | 23 | 32 | 30 | 47 | 127 |
| | + | 50ppt | 27 | 36 | 35 | 43 | 161 |
| | + | 100ppt | 16 | 36 | 23 | 48 | 131 |
| | + | 500ppt | 24 | 30 | 25 | 44 | 145 |
| | + | 1000ppt | 21 | 30 | 49 | 53 | 172 |

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* Formed precipitate when plated.

## Table 14

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## $RO_3$-9

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | |
|---|---|---|---|---|---|---|---|
| | | | TA1535 | TA1537 | TA1538 | TA98 | TA100 |
| Negative control (dioxane) | - | 100,000 | 72,53 | 28,17 | 10,11 | 32,30 | 150,141 |
| | + | 100,000 | 20,16 | 52,45 | 24,25 | 41,37 | 153,162 |
| Positive controls | | | | | | | |
| Sodium azide | - | 0.5 | 411 | | | | 660 |
| 9-Aminoacridine | - | 50.0 | | 161 | | | |
| 2-Nitrofluorene | - | 5.0 | | | 736 | 475 | |
| 2-Anthramine | - | 1.0 | | | 27 | 26 | 123 |
| | + | 1.0 | | | 251 | 197 | 318 |
| | - | 2.5 | 57 | 28 | | | |
| | + | 2.5 | 147 | 92 | | | |
| $RO_3$-9 | - | 5 | 42 | 26 | 23 | 35 | 164 |
| | - | 10 | 39 | 24 | 15 | 38 | 159 |
| | - | 50ppt* | 47 | 19 | 21 | 28 | 142 |
| | - | 100ppt | 51 | 25 | 21 | 45 | 155 |
| | - | 500ppt | 53 | 18 | 27 | 40 | 155 |
| | - | 1000ppt | 53 | 21 | 33 | 27 | 152 |
| | + | 5 | 23 | 45 | 29 | 39 | 146 |
| | + | 10 | 26 | 46 | 23 | 48 | 151 |
| | + | 50ppt | 19 | 39 | 31 | 45 | 146 |
| | + | 100ppt | 22 | 50 | 21 | 50 | 145 |
| | + | 500ppt | 29 | 33 | 38 | 40 | 165 |
| | + | 1000ppt | 24 | 46 | 44 | 44 | 161 |

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* Formed precipitate when plated.

SRI International

CLIENT PRIVATE

# IN VITRO MICROBIOLOGICAL MUTAGENICITY ASSAYS OF 42 COLUMN CHROMATOGRAPHY RECOVERED FRACTIONS

Final Report

July 1979

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# SUMMARY

SRI International examined 42 Westinghouse Electric Corporation samples, RO 1 (1-7), RO 5A (1-7), RO 12A (1-7), RO 14 (1-7), RO 15 (1-7), and RO 16 (1-7) for mutagenic activity with strains TA1535, TA1537, TA1538, TA98, and TA100 of the bacterium *Salmonella typhimurium* in the standard Ames *Salmonella*/microsome assay. Each assay was performed in the presence and in the absence of a rat liver metabolic activation system.

Samples RO 1-1, RO 5A-1, RO 12A-1, RO 14-1, RO 15-1, and RO 16-1 were not mutagenic in the Ames *Salmonella*/microsome assay.

Samples 2 to 7 of RO 1, 2 to 7 of RO 5A, 2 to 6 of RO 12A, and 2 to 6 of RO 14, 2 to 6 of RO 15, and 2 to 7 of RO 16 contained frameshift mutagens and primarily affected strains TA1537, TA1538, TA98, and TA100.

Samples RO 12A-7, RO 14-7, and RO 15-7 caused some low increases in the number of histidine-independent revertants. However, because of the limited amounts of samples supplied, we were unable to test these samples sufficiently and hence are unable to draw any firm conclusion regarding their mutagenic potential.

A few samples appeared to be slightly toxic at several of the high doses. These are indicated by P (pinpoint background) on the individual tables.

# INTRODUCTION

SRI International examined 42 Westinghouse Electric Corporation samples—RO 1 (1-7), RO 5A (1-7), RO 12A (1-7), RO 14 (1-7), RO 15 (1-7), and RO 16 (1-7)--for mutagenic activity, using in vitro microbiological assays with strains TA1535, TA1537, TA1538, TA98, and TA100 of the bacterium Salmonella typhimurium in the standard Ames Salmonella/microsome assay. An Aroclor 1254-stimulated, rat liver homogenate metabolic activation system was included in the assay procedures to provide metabolic steps that the bacteria either are incapable of conducting or do not carry out under the assay conditions.

The assay procedure with S. typhimurium has proven to be 80 to 90% reliable in detecting carcinogens as mutagens, and it has about the same reliability in identifying chemicals that are not carcinogenic.[1] However, because the test system does not always provide 100% correlation with carcinogenicity investigations in animals, neither a positive nor a negative response conclusively proves that a chemical is hazardous or nonhazardous to man.

## RESULTS AND DISCUSSION

Tables 1 through 86 present the results of the Salmonella/microsome assays conducted on Westinghouse samples RO 1 (1-7), RO 5A (1-7), RO 12A (1-7), RO 14 (1-7), RO 15 (1-7), and RO 16 (1-7). These samples were tested over a wide range of concentrations from 10 to 2500 µg/plate (sample size permitting). Many of the samples were not miscible with the top agar or formed precipitates when plated. This incompatability with the aqueous test medium may explain some of the variations in results observed with some of the samples.

### RO 1-1: Tables 1-3

No reproducible, dose-related increases in the number of histidine-independent revertants were observed in any of the assays performed with sample RO 1-1. Therefore, we conclude that RO 1-1 is not mutagenic in the Salmonella/microsome assay.

### RO 1-2: Tables 4 and 5

RO 1-2 induced reproducible, dose-related increases in revertants in Salmonella typhimurium strains TA1538, TA98, and TA100 in the presence of the metabolic activation system. Therefore we conclude that this sample is mutagenic.

### RO 1-3: Tables 6 and 7

Sample RO 1-3 was mutagenic in assays with strains TA1537, TA1538, TA98, and TA100. In the first assay (Table 6), mutagenicity was observed in TA1538, TA98, and TA100 in the presence of metabolic activation and in strains TA98 and TA100 in the absence of metabolic activation. In the second assay (Table 7), RO 1-3 was mutagenic in assays with all four of these strains, both in the presence and in the absence of metabolic activation. In both assays, RO 1-3 was more mutagenic when the metabolic activation system was included.

### RO 1-4: Tables 8 and 9

Both experiments conducted with RO 1-4 demonstrated mutagenic activity in strains TA98 and TA100 in the presence of metabolic activation. In the first experiment, an elevation in the number of histidine-independent revertants was also observed in strain TA1538 in the presence of metabolic activation. We conclude that this sample is mutagenic with strains TA98 and TA100 in the presence of the metabolic activation system.

### RO 1-5: Tables 10 and 11

RO 1-5 was mutagenic to strains TA1538, TA98, and TA100 in the presence of metabolic activation. Some elevations in the number of revertants were also observed in TA1537 in the presence of metabolic activation.

### RO 1-6: Tables 12 through 14

In the first experiment conducted with RO 1-6 (Table 12), irregular, dose-related increases in the number of revertants were observed in strains TA1538, TA98, and TA100, primarily at the higher dose levels in the presence of the metabolic activation system. In the second experiment (Table 13), this was true for strains TA98 and TA100, but not for TA1538. Therefore a third experiment was performed (Table 14). Due to the limited amount of sample, the highest dose tested was 1000 µg/plate and plating was done only with TA100; in this experiment, a clear dose-related increase in the presence of metabolic activation was observed. We conclude that this sample is mutagenic with strain TA100. Without further testing, we cannot make any firm conclusions regarding its mutagenic potential with strains TA1538 and TA98. However, we suspect that this chemical may be mutagenic with these strains, too.

RO 1-7: Table 15

Due to the small amount of sample received, only one experiment was performed with sample RO 1-7. In this assay, RO 1-7 was mutagenic with strains TA1538, TA98, and TA100 in the presence of the metabolic activation system.

RO 5A-1: Tables 16 and 17

No mutagenic activity was observed in any of the assays conducted with sample RO 5A-1.

RO 5A-2: Tables 18 and 19

RO 5A-2 was mutagenic with strains TA1537, TA1538, TA98, and TA100 in the presence of the metabolic activation system.

RO 5A-3: Tables 20 and 21, and RO 5A-4: Tables 22 and 23

In the assays conducted with RO 5A-3 and RO 5A-4, reproducible dose-related increases were observed in strains TA1538, TA98, and TA100 in the presence of the metabolic activation system. Both samples were also mutagenic with strains TA1538 and TA98 in the absence of the metabolic activation system. Both samples caused elevations in strain TA100 in the first experiments (Tables 20 and 22, respectively) in the absence of the metabolic activation system.

RO 5A-5: Tables 24 and 25

Mutagenic activity was observed in strains TA1538, TA98, and TA100 in the presence of the metabolic activation system in assays conducted with RO 5A-5. Some elevations in the number of histidine-independent revertants were also observed in strains TA1538 and TA98 in the absence of the metabolic activation system (Table 24).

RO 5A-6: Tables 26 and 27

In two experiments, RO 5A-6 caused dose-related increases in revertants with strains TA1538 and TA100 in the presence of the metabolic activation system. In the second experiment (Table 27), a dose-related response was also observed in strain TA98 in the presence of the metabolic activation system. We conclude that this sample is mutagenic with strains TA1538 and TA100 in the presence of the metabolic activation system. It may also be mutagenic to strain TA98; however, more sample for further testing would be required to definitely establish this.

### RO 5A-7: Table 28

Only one assay was performed on sample RO 5A-7 due to the limited amount supplied. In this assay, mutagenic activity was observed in strains TA1538, TA98, and TA100 in the presence of the metabolic activation system.

### RO 12A-1: Tables 29 through 31

For the assays performed with sample RO 12A-1, no reproducible increases were observed in any of the strains. Therefore, we conclude that RO 12A-1 is not a mutagen in the *Salmonella*/microsome assay.

### RO 12A-2: Tables 32 and 33

Reproducible dose-related responses with strains TA98 and TA100 in the presence of the metabolic activation system were obtained with RO 12A-2. In the first assay (Table 32), an elevation in the number of revertants was observed in strain TA1538 in the presence of the metabolic activation system. In the second experiment (Table 33), a similar elevation was observed in TA1537 in the presence of the metabolic activation system.

### RO 12A-3: Tables 34 and 35

Sample RO 12A-3 was found to be mutagenic with strains TA1538, TA98, and TA100 in the presence of the metabolic activation system. Some irregular elevations in the number of revertants were also observed in strains TA1537, TA1538, and TA98 in the absence of the metabolic activation system.

### RO 12A-4: Tables 36 through 38

In the first assay performed with 12A-4 (Table 36), mutagenicity was observed in strains TA1538, TA98, and TA100 in the presence of the metabolic activation system. This was confirmed in a second experiment (Table 37), although the activity was slightly irregular and the increases were smaller. Also, in the first experiment (Table 36), dose-related increases were observed in strains TA1537 and TA1538 and irregular elevations in the number of revertants were observed in TA98, all in the absence of the metabolic activation system. The mutagenic effect of RO 12A-4 with strain TA100 was confirmed in a third assay (Table 38).

### RO 12A-5: Tables 39 and 40

RO 12A-5 was mutagenic with strains TA1538, TA98, and TA100 in the presence of the metabolic activation system. Some elevation in the number of revertants was also observed in these strains in the first experiment (Table 39) in the absence of the metabolic activation system.

### RO 12A-6: Tables 41 through 43

In the first experiment conducted with RO 12A-6 (Table 41), elevations in the number of revertants were observed in strains TA1538, TA98, and TA100 in the presence of the metabolic activation system at the highest doses. In the second experiment (Table 42), dose-related increases were again observed in these strains in the presence of the metabolic activation system at the higher doses. These increases were investigated further in a third experiment (Table 43), which reproduced the dose-related responses previously observed in strains TA1538 and TA100 in the presence of the metabolic activation system, but not in strain TA98. We concluded that RO 12A-6 was weakly mutagenic with strains TA1538 and TA100 and may be mutagenic with strain TA98. More sample would be required to further investigate the effect of RO 12A-6 on strain TA98.

RO 12A-7: Tables 44 and 45

In the two assays performed on RO 12A-7, elevations in the number of revertants were observed at the highest doses in strains TA1537, TA1538, TA98, and TA100 in the presence of the metabolic activation system. Due to the limited amount of sample supplied, we were unable to further investigate this effect. We suspect however, that this sample may be mutagenic at higher doses in the presence of the metabolic activation system.

RO 14-1: Table 46 and 47

No reproducible mutagenic activity was observed in any of the tests performed with sample RO 14-1.

RO 14-2: Tables 48 and 49

RO 14-2 was found to be a mutagen affecting strains TA1538, TA98, and TA100 in the presence of the metabolic activation system. Slight elevations were also observed in both assays in strain TA1537 in the presence of the metabolic activation system.

RO 14-3: Tables 50 and 51

In both assays, RO 14-3 was mutagenic with strains TA1537, TA1538, TA98, and TA100 both in the presence and absence of the metabolic activation system.

RO 14-4: Tables 52 and 53

RO 14-4 caused reproducible increases in number of revertants with strains TA1538, TA98, and TA100 in the presence of the metabolic activation system. In the absence of the metabolic activation system, slight dose-related elevations were also observed in TA1538 and TA98.

RO 14-5: Tables 54 and 55

In the one complete experiment that was performed on RO 14-5, mutagenic activity was observed in strains TA1538, TA98, and TA100 in the presence of the metabolic activation system. This was confirmed in strain TA100 in the second experiment. Due to the limited amount of sample supplied, assays with TA98 were incomplete and no additional tests could be conducted with TA1538.

### RO 14-6: Tables 56 and 57

RO 14-6 was mutagenic in two assays with strains TA98 and TA100 in the presence of the metabolic activation system. In the second assay (Table 57), a dose-related increase in strain TA1538 in the presence of metabolic activation was also observed. Because of the limited amount of sample supplied, the activity in TA1538 was not further investigated. We conclude that this sample is mutagenic to TA98 and TA100 in the presence of metabolic activation.

### RO 14-7: Table 58

Due to the limited amount of sample supplied, only one assay was performed with RO 14-7. In this experiment, a dose-related increase was observed with TA100 in the presence of the metabolic activation system. An elevation of revertants was also observed at the highest doses in strains TA1538 and TA98 in the presence of the metabolic activation system. Without further investigation, we cannot make a statement regarding the mutagenic potential of RO 14-7. However, we suspect that at higher doses this chemical would prove to be mutagenic in the presence of the metabolic activation system.

### RO 15-1: Tables 59 and 60

RO 15-1 was not mutagenic in any of the assays performed.

### RO 15-2: Tables 61 and 62

RO 15-2 was mutagenic in strains TA1538, TA98, and TA100 in both assays in the presence of the metabolic activation system. In the second experiment, dose-related increases in the number of revertants were also observed in strain TA1537 in the presence of the metabolic activation system. We conclude that this sample is a frameshift mutagen requiring metabolic activation.

RO 15-3: Tables 63 and 64

This sample is a mutagen that affected strains TA1537, TA1538, TA98, and TA100 both in the presence and absence of the metabolic activation system.

RO 15-4: Tables 65 and 66, and RO 15-5: Tables 67 and 68

Samples RO 15-4 and RO 15-5 were found to be mutagens in tests with strains TA1538, TA98, and TA100 only in the presence of the metabolic activation system.

RO 15-6: Tables 69 and 70

In both experiments, dose responses were observed in strains TA98 and TA100 in the presence of the metabolic activation system. In the initial assay (Table 69), mutagenic activity was also observed in strain TA1538 at higher doses with metabolic activation. We conclude that this sample is mutagenic in the *Salmonella*/microsome assay.

RO 15-7: Table 71

Only one assay was performed on sample RO 15-7 due to the limited amount supplied. In that assay with strains TA98 and TA100, a small increase in revertants in the presence of the metabolic activation system was observed. However, without further investigation of this sample, we can draw no conclusions regarding its mutagenic potential.

RO 16-1: Tables 72 and 73

RO 16-1 was not mutagenic in any of the assays performed.

RO 16-2: Tables 74 through 76

In the first two assays of RO 16-2, mutagenic dose responses were observed in strains TA1538, TA98, and TA100 in the presence of the metabolic activation system. However, responses in TA1538 and TA100 were not as clear-cut in the first experiment as in the second. In a third test (Table 76), the clear-cut dose-related responses previously observed in strains TA1538 and TA100 in the presence of the metabolic activation system were seen again. We conclude that RO 16-2 is mutagenic with strains TA1538, TA98, and TA100 with metabolic activation.

## RO 16-3: Tables 77 and 78

RO 16-3 was mutagenic with strains TA1537, TA1538, TA98, and TA100 both in the presence and in the absence of the metabolic activation system.

## RO 16-4: Tables 79 and 80

In the two assays performed with RO 16-4, mutagenic activity was observed in strains TA1537, TA1538, TA98, and TA100 in the presence of the metabolic activation system. Mutagenic activity was also observed in TA1537, TA98, and TA100 in the absence of the metabolic activation system in both assays.

## RO 16-5: Tables 81 and 82

In both assays of RO 16-5, dose-related increases in the number of revertants were observed in strains TA1538, TA98, and TA100 in the presence of the metabolic activation system. In the second assay (Table 82), a dose-related increase was also observed in TA1537 with metabolic activation.

## RO 16-6: Tables 83 and 84

In both assays of RO 16-6, dose-related increases in the number of revertants were observed in strains TA1538, TA98, and TA100 in the presence of the metabolic activation system. In the second assay (Table 84), a dose-related increase was also observed in TA1537 with metabolic activation.

### RO 16-7: Tables 85 and 86

Due to the limited amount of sample supplied, only one complete assay was conducted. In that experiment (Table 85), increases in the number of revertants were observed in strains TA98 and TA100 at the higher doses with metabolic activation. These increases were observed in a second experiment conducted with TA100; however, only a narrow range of doses was tested due to a lack of chemical. From these two tests it appeared that RO 16-7 was clearly mutagenic to TA100 in the presence of the metabolic activation system, and we would expect similar results in strain TA98 if tested at higher doses.

Table 1

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 1-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 26 | 32 | 12 | 13 | 8 | 19 | 30 | 19 | 109 | 91 |
| | + | 50000 | 8 | 13 | 9 | 14 | 29 | 24 | 29 | 32 | 109 | 117 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 367 | 373 | | | | | | | 593 | 576 |
| 9-Aminoacridine | - | 50.0 | | | 307 | 294 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 700 | 433 | 332 | 381 | | |
| 2-Anthramine | + | 2.5 | 177 | 277 | 77 | 84 | 165 | 149 | 141 | 112 | 260 | 295 |
| RO 1-1 | - | 10 | | 30 | | 8 | | 13 | | 27 | | 113 |
| | - | 50 | | 31 | | 6 | | 15 | | 40 | | 99 |
| | - | 100 | | 32 | | 12 | | 14 | | 28 | | 101 |
| | - | 500 | | 50 | | 13 | | 16 | | 28 | | 125 |
| | - | 1000 | | 48 | | 8 | | 14 | | 19 | | 126 |
| | - | 2500 | | 36 | | 4 | | 29 | | 24 | | 101 |
| | + | 10 | | 7 | | 15 | | 15 | | 30 | | 124 |
| | + | 50 | | 16 | | 9 | | 27 | | 27 | | 142 |
| | + | 100 | | 9 | | 17 | | 9 | | 32 | | 123 |
| | + | 500 | | 6 | | 12 | | 27 | | 48 | | 93 |
| | + | 1000 | | 15 | | 8 | | 27 | | 44 | | 152 |
| | + | 2500 | | 18 | | 17 | | 26 | | 45 | | 134 |

## Table 2

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 1-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 20 | 13 | 15 | 6 | 13 | 36 | 33 | 118 | 149 |
| | + | 50000 | 15 | 6 | 12 | 18 | 15 | 20 | 38 | 43 | 167 | 152 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 509 | 501 | | | | | | | 752 | 712 |
| 9-Aminoacridine | - | 50.0 | | | 215 | 208 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 353 | 432 | 212 | 211 | | |
| 2-Anthramine | + | 2.5 | 81 | 69 | 152 | 183 | 516 | 552 | 927 | 861 | 1091 | 982 |
| RO 1-1 | - | 10 | | 14 | | 19 | | 16 | | 36 | | 115 |
| | - | 50 | | 15 | | 17 | | 6 | | 32 | | 138 |
| | - | 100 | | 15 | | 25 | | 12 | | 30 | | 135 |
| | - | 500 | | 19 | | 17 | | 9 | | 60 | | 117 |
| | - | 1000 | | 16 | | 18 | | 11 | | 57 | | 147 |
| | - | 2500 | | 18 | | 10 | | 14 | | 44 | | 135 |
| | + | 10 | | 9 | | 14 | | 10 | | 27 | | 110 |
| | + | 50 | | 16 | | 14 | | 5 | | 29 | | 146 |
| | + | 100 | | 13 | | 16 | | 17 | | 40 | | 123 |
| | + | 500 | | 10 | | 14 | | 19 | | 39 | | 149 |
| | + | 1000 | | 14 | | 30 | | 11 | | 40 | | 177 |
| | + | 2500 | | 11 | | 18 | | 18 | | 46 | | 183 |

## Table 3

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 1-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1538 | | | TA98 | | | TA100 | | |
| Negative control | | | | | | | | | | | |
| Dioxane | + | 50,000 | 31 | 33 | 61 | 68 | 50 | 56 | 161 | 126 | 174 |
| Positive controls | | | | | | | | | | | |
| Sodium azide | - | 1.0 | | | | | | | | 446 | 435 |
| 2-Nitrofluorene | - | 5.0 | | 539 | 498 | | 356 | 661 | | | |
| 2-Anthramine | + | 2.5 | | 677 | 631 | | 482 | 497 | | 890 | 1211 |
| RO 1-1 | + | 50 | | | | | 42 | 29 | | 161 | 163 |
| | + | 100 | | | | | 42 | 32 | | 128 | 129 |
| | + | 250 | | | | | 48 | 42 | | 153 | 175 |
| | + | 500 | | | | | 55 | 56 | | 177 | 170 |
| | + | 750 | | | | | 43 | 32 | | 165 | 152 |
| | + | 1000 | | | | | 55 | 80 | | 171 | 153 |
| | + | 1500 | | | | | 49 | 41 | | 174 | 162 |
| | + | 2000 | | | | | 51 | 45 | | 188 | 162 |
| | + | 2500 | | | | | 37 | 63 | | 173 | 172 |

Table 4

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 1-2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 26 | 32 | 12 | 13 | 8 | 19 | 30 | 19 | 109 | 91 |
| | + | 50000 | 8 | 13 | 9 | 14 | 29 | 24 | 29 | 32 | 109 | 117 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 367 | 373 | | | | | | | 593 | 576 |
| 9-Aminoacridine | - | 50.0 | | | 307 | 294 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 700 | 433 | 332 | 381 | | |
| 2-Anthramine | + | 2.5 | 177 | 277 | 77 | 84 | 165 | 149 | 141 | 112 | 260 | 295 |
| RO 1-2 | - | 10 | | 33 | | 9 | | 15 | | 28 | | 96 |
| | - | 50 | | 21 | | 12 | | 8 | | 33 | | 87 |
| | - | 100 | | 24 | | 6 | | 9 | | 26 | | 79 |
| | - | 500 | | 28 | | 5 | | 9 | | 21 | | 72 |
| | - | 1000 | | 31 | | 5 | | 12 | | 25 | | 73 |
| | - | 2500 | | 25 | | 18 | | 10 | | 38 | | 87 |
| | + | 10 | | 17 | | 13 | | 32 | | 30 | | 114 |
| | + | 50 | | 9 | | 9 | | 45 | | 77 | | 167 |
| | + | 100 | | 5 | | 26 | | 44 | | 78 | | 201 |
| | + | 500 | | 16 | | 21 | | 60 | | 127 | | 224 |
| | + | 1000 | | 4 | | 24 | | 67 | | 98 | | 245 |
| | + | 2500 | | 8 | | 19 | | 74 | | 100 | | 237 |

## Table 5

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 1-2

| | | | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 20 | 13 | 15 | 6 | 13 | 36 | 33 | 118 | 149 |
| | + | 50000 | 15 | 6 | 12 | 18 | 15 | 20 | 38 | 43 | 167 | 152 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 509 | 501 | | | | | | | 752 | 712 |
| 9-Aminoacridine | - | 50.0 | | | 215 | 208 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 353 | 432 | 212 | 211 | | |
| 2-Anthramine | + | 2.5 | 81 | 69 | 152 | 183 | 516 | 552 | 927 | 861 | 1091 | 982 |
| RO 1-2 | - | 10 | | 17 | | 13 | | 17 | | 48 | | 146 |
| | - | 50 | | 19 | | 14 | | 15 | | 42 | | 117 |
| | - | 100 | | 21 | | 30 | | 7 | | 48 | | 127 |
| | - | 500 | | 20 | | 24 | | 15 | | 51 | | 124 |
| | - | 1000 | | 17 | | 20 | | 12 | | 64 | | 141 |
| | - | 2500 | | 21 | | 21 | | 13 | | 48 | | 146 |
| | + | 10 | | 9 | | 26 | | 12 | | 33 | | 164 |
| | + | 50 | | 15 | | 24 | | 14 | | 69 | | 191 |
| | + | 100 | | 7 | | 30 | | 31 | | 75 | | 211 |
| | + | 500 | | 14 | | 26 | | 28 | | 98 | | 293 |
| | + | 1000 | | 6 | | 28 | | 39 | | 91 | | 272 |
| | + | 2500 | | 13 | | 20 | | 23 | | 90 | | 259 |

# Table 6

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 1-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 1-3 | - | 10 | | 17 | | 10 | | 19 | | 49 | | 153 |
| | - | 50 | | 18 | | 14 | | 14 | | 48 | | 131 |
| | - | 100* | | 18 | | 14 | | 14 | | 49 | | 178 |
| | - | 500* | | 25 | | 8 | | 26 | | 98 | | 191 |
| | - | 1000* | | 14 | | 8 | | 26 | | 103 | | 227 |
| | - | 2500* | | 20 | | 3 | | 26 | | 57 | | 222 |
| | + | 10 | | 5 | | 16 | | 36 | | 57 | | 182 |
| | + | 50 | | 9 | | 24 | | 56 | | 80 | | 262 |
| | + | 100* | | 13 | | 30 | | 57 | | 119 | | 429 |
| | + | 500* | | 8 | | 33 | | 101 | | 157 | | 447 |
| | + | 1000* | | 10 | | 38 | | 93 | | 153 | | 481 |
| | + | 2500* | | 11 | | 32 | | 112 | | 124 | | 479 |

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*Formed precipitate when plated.

## Table 7

## *IN VITRO* ASSAYS WITH *SALMONELLA TYPHIMURIUM*

### RO 1-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 20 | 13 | 15 | 6 | 13 | 36 | 33 | 118 | 149 |
| | + | 50000 | 15 | 6 | 12 | 18 | 15 | 20 | 38 | 43 | 167 | 152 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 509 | 501 | | | | | | | 752 | 712 |
| 9-Aminoacridine | - | 50.0 | | | 215 | 208 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 353 | 432 | 212 | 211 | | |
| 2-Anthramine | + | 2.5 | 81 | 69 | 152 | 183 | 516 | 552 | 927 | 861 | 1091 | 982 |
| RO 1-3 | - | 10 | | 16 | | 18 | | 17 | | 41 | | 153 |
| | - | 50 | | 15 | | 23 | | 10 | | 61 | | 159 |
| | - | 100* | | 19 | | 24 | | 16 | | 49 | | 172 |
| | - | 500* | | 17 | | 46 | | 25 | | 84 | | 264 |
| | - | 1000* | | 19 | | 40 | | 38 | | 128 | | 223 |
| | - | 2500* | | 23 | | 25 | | 39 | | 137 | | 196 |
| | + | 10 | | 6 | | 28 | | 33 | | 70 | | 244 |
| | + | 50 | | 11 | | 33 | | 44 | | 85 | | 339 |
| | + | 100* | | 4 | | 44 | | 49 | | 124 | | 465 |
| | + | 500* | | 14 | | 46 | | 53 | | 184 | | 520 |
| | + | 1000* | | 8 | | 50 | | 53 | | 191 | | 555 |
| | + | 2500* | | 8 | | 49 | | 59 | | 196 | | 401 |

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*Formed precipitate when plated.

Table 8

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 1-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 1-4 | - | 10 | | 25 | | 4 | | 27 | | 57 | | 125 |
| | - | 50* | | 27 | | 7 | | 14 | | 32 | | 137 |
| | - | 100* | | 50 | | 9 | | 14 | | 36 | | 146 |
| | - | 500* | | 43 | | 13 | | 21 | | 42 | | 131 |
| | - | 1000* | | 41 | | 16 | | 23 | | 51 | | 173 |
| | - | 2500* | | 41 | | 15 | | 20 | | 30 | | 159 |
| | + | 10 | | 8 | | 14 | | 29 | | 60 | | 93 |
| | + | 50* | | 7 | | 17 | | 42 | | 63 | | 161 |
| | + | 100* | | 12 | | 16 | | 69 | | 85 | | 201 |
| | + | 500* | | 25 | | 21 | | 72 | | 109 | | 233 |
| | + | 1000* | | 16 | | 28 | | 66 | | 100 | | 241 |
| | + | 2500* | | 13 | | 17 | | 99 | | 99 | | 227 |

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*Formed precipitate when plated.

## Table 9

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 1-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 20 | 13 | 15 | 6 | 13 | 36 | 33 | 118 | 149 |
| | + | 50000 | 15 | 6 | 12 | 18 | 15 | 20 | 38 | 43 | 167 | 152 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 509 | 501 | | | | | | | 752 | 712 |
| 9-Aminoacridine | - | 50.0 | | | 215 | 208 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 353 | 432 | 212 | 211 | | |
| 2-Anthramine | + | 2.5 | 81 | 69 | 152 | 183 | 516 | 552 | 927 | 861 | 1091 | 982 |
| RO 1-4 | - | 10 | | 17 | | 19 | | 13 | | 45 | | 167 |
| | - | 50* | | 21 | | 19 | | 8 | | 36 | | 140 |
| | - | 100* | | 22 | | 30 | | 7 | | 38 | | 167 |
| | - | 500* | | 14 | | 27 | | 14 | | 66 | | 169 |
| | - | 1000* | | 18 | | 27 | | 13 | | 47 | | 161 |
| | - | 2500* | | NT | | NT | | NT | | NT | | NT |
| | + | 10 | | 12 | | 23 | | 17 | | 57 | | 163 |
| | + | 50* | | 14 | | 24 | | 17 | | 78 | | 228 |
| | + | 100* | | 13 | | 27 | | 30 | | 78 | | 259 |
| | + | 500* | | 9 | | 34 | | 22 | | 66 | | 267 |
| | + | 1000* | | 9 | | 29 | | 26 | | 83 | | 277 |
| | + | 2500* | | NT† | | NT | | 25 | | 66 | | 201 |

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*Formed precipitate when plated.

†NT, not tested.

Table 10

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 1-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 1-5 | - | 10 | | 18 | | 14 | | 13 | | 36 | | 134 |
| | - | 50 | | 21 | | 13 | | 10 | | 52 | | 104 |
| | - | 100* | | 17 | | 12 | | 12 | | 51 | | 128 |
| | - | 500* | | 16 | | 17 | | 27 | | 67 | | 149 |
| | - | 1000* | | 29 | | 17 | | 26 | | 50 | | 149 |
| | - | 2500* | | 17 | | 7 | | 24 | | 33 | | 135 |
| | + | 10 | | 16 | | 18 | | 23 | | 40 | | 117 |
| | + | 50 | | 11 | | 14 | | 31 | | 52 | | 126 |
| | + | 100* | | 7 | | 19 | | 33 | | 53 | | 227 |
| | + | 500* | | 8 | | 34 | | 49 | | 107 | | 320 |
| | + | 1000* | | 9 | | 37 | | 59 | | 123 | | 389 |
| | + | 2500* | | 10 | | 27 | | 56 | | 124 | | 380 |

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*Formed precipitate when plated.

## Table 11

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 1-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 20 | 13 | 15 | 6 | 13 | 36 | 33 | 118 | 149 |
| | + | 50000 | 15 | 6 | 12 | 18 | 15 | 20 | 38 | 43 | 167 | 152 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 509 | 501 | | | | | | | 752 | 712 |
| 9-Aminoacridine | - | 50.0 | | | 215 | 208 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 353 | 432 | 212 | 211 | | |
| 2-Anthramine | + | 2.5 | 81 | 69 | 152 | 183 | 516 | 552 | 927 | 861 | 1091 | 982 |
| RO 1-5 | - | 10 | | 23 | | 23 | | 11 | | 50 | | 155 |
| | - | 50 | | 22 | | 32 | | 15 | | 45 | | 149 |
| | - | 100* | | 14 | | 24 | | 15 | | 51 | | 149 |
| | - | 500* | | 15 | | 23 | | 14 | | 48 | | 166 |
| | - | 1000* | | 13 | | 17 | | 14 | | 53 | | 177 |
| | - | 2500* | | 20 | | 36 | | 23 | | 53 | | 149 |
| | + | 10 | | 11 | | 18 | | 13 | | 40 | | 158 |
| | + | 50 | | 9 | | 28 | | 10 | | 72 | | 231 |
| | + | 100* | | 9 | | 27 | | 21 | | 74 | | 242 |
| | + | 500* | | 12 | | 30 | | 29 | | 76 | | 325 |
| | + | 1000* | | 11 | | 27 | | 35 | | 78 | | 315 |
| | + | 2500* | | 1 | | 32 | | 31 | | 68 | | 222 |

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*Formed precipitate when plated.

## Table 12

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 1-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 1-6 | - | 1 | | 24 | | 7 | | 13 | | 36 | | 126 |
| | - | 5 | | 15 | | 5 | | 7 | | 39 | | 141 |
| | - | 10* | | 20 | | 13 | | 16 | | 42 | | 137 |
| | - | 50* | | 16 | | 14 | | 15 | | 45 | | 131 |
| | - | 100* | | 27 | | 9 | | 10 | | 43 | | 121 |
| | - | 500* | | 13 | | 9 | | 13 | | 40 | | 134 |
| | + | 1 | | 5 | | 17 | | 19 | | 40 | | 128 |
| | + | 5 | | 12 | | 13 | | 17 | | 55 | | 128 |
| | + | 10* | | 8 | | 18 | | 20 | | 37 | | 146 |
| | + | 50* | | 14 | | 25 | | 23 | | 38 | | 141 |
| | + | 100* | | 11 | | 13 | | 28 | | 60 | | 144 |
| | - | 500* | | 8 | | 16 | | 38 | | 60 | | 205 |

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*Formed precipitate when plated.

## Table 13

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 1-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 20 | 13 | 15 | 6 | 13 | 36 | 33 | 118 | 149 |
| | + | 50000 | 15 | 6 | 12 | 18 | 15 | 20 | 38 | 43 | 167 | 152 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 509 | 501 | | | | | | | 752 | 712 |
| 9-Aminoacridine | - | 50.0 | | | 215 | 208 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 353 | 432 | 212 | 211 | | |
| 2-Anthramine | + | 2.5 | 81 | 69 | 152 | 183 | 516 | 552 | 927 | 861 | 1091 | 982 |
| RO 1-6 | - | 1 | | 18 | | 17 | | 11 | | 50 | | 175 |
| | - | 5 | | 19 | | 20 | | 16 | | 38 | | 146 |
| | - | 10 | | 24 | | 26 | | 13 | | 48 | | 145 |
| | - | 50* | | 21 | | 19 | | 8 | | 35 | | 164 |
| | - | 100* | | 17 | | 24 | | 11 | | 36 | | 164 |
| | - | 500* | | 27 | | 23 | | 13 | | 49 | | 125 |
| | + | 1 | | 12 | | 20 | | 12 | | 36 | | 153 |
| | + | 5 | | 6 | | 21 | | 13 | | 38 | | 173 |
| | + | 10 | | 4 | | 24 | | 14 | | 42 | | 157 |
| | + | 50* | | 11 | | 29 | | 22 | | 48 | | 155 |
| | + | 100* | | 6 | | 22 | | 15 | | 46 | | 192 |
| | + | 500* | | 7 | | 24 | | 18 | | 58 | | 228 |

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*Formed precipitate when plated.

## Table 14

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

## RO 1-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1538 | | | TA98 | | | TA100 | | |
| Negative control | | | | | | | | | | | |
| Dioxane | + | 50,000 | 31 | 33 | 61 | 68 | 50 | 56 | 161 | 126 | 174 |
| Positive controls | | | | | | | | | | | |
| Sodium azide | - | 1.0 | | | | | | | | 446 | 435 |
| 2-Nitrofluorene | - | 5.0 | | 539 | 498 | | 356 | 661 | | | |
| 2-Anthramine | + | 2.5 | | 677 | 631 | | 482 | 497 | | 890 | 1211 |
| RO 1-6 | + | 150 | | | | | | | | | 213 |
| | + | 250 | | | | | | | | | 222 |
| | + | 500 | | | | | | | | | 230 |
| | + | 750 | | | | | | | | | 252 |
| | + | 1000 | | | | | | | | | 227 |

Table 15

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 1-7

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 1-7 | - | 1 | | 32 | | 16 | | 22 | | 56 | | 138 |
| | - | 5 | | 19 | | 15 | | 23 | | 62 | | 167 |
| | - | 10 | | 26 | | 23 | | 26 | | 54 | | 184 |
| | - | 50* | | 30 | | 27 | | 22 | | 49 | | 185 |
| | - | 100* | | 33 | | 30 | | 24 | | 49 | | 177 |
| | - | 500* | | 26 | | 27 | | 23 | | 49 | | 160 |
| | + | 1 | | 8 | | 34 | | 18 | | 49 | | 166 |
| | + | 5 | | 8 | | 42 | | 20 | | 55 | | 160 |
| | + | 10 | | 12 | | 45 | | 26 | | 44 | | 161 |
| | + | 50* | | 6 | | 45 | | 30 | | 49 | | 187 |
| | + | 100* | | 13 | | 40 | | 26 | | 64 | | 220 |
| | + | 500* | | 12 | | 35 | | 48 | | 71 | | 255 |

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*Formed precipitate when plated.

## Table 16

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 5A-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 26 | 32 | 12 | 13 | 8 | 19 | 30 | 19 | 109 | 91 |
| | + | 50000 | 8 | 13 | 9 | 14 | 29 | 24 | 29 | 32 | 109 | 117 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 367 | 373 | | | | | | | 593 | 576 |
| 9-Aminoacridine | - | 50.0 | | | 307 | 294 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 700 | 433 | 332 | 381 | | |
| 2-Anthramine | + | 2.5 | 177 | 277 | 77 | 84 | 165 | 149 | 141 | 112 | 260 | 295 |
| RO 5A-1 | - | 10 | | 14 | | 8 | | 5 | | 24 | | 103 |
| | - | 50 | | 6 | | 6 | | 13 | | 28 | | 90 |
| | - | 100 | | 9 | | 7 | | 8 | | 24 | | 99 |
| | - | 500 | | 17 | | 8 | | 17 | | 27 | | 73 |
| | - | 1000 | | 20 | | 15 | | 14 | | 25 | | 75 |
| | - | 2500 | | 17 | | 5 | | 17 | | 20 | | 90 |
| | + | 10 | | 13 | | 9 | | 16 | | 39 | | 111 |
| | + | 50 | | 6 | | 14 | | 26 | | 32 | | 102 |
| | + | 100 | | 6 | | 14 | | 17 | | 40 | | 85 |
| | + | 500 | | 9 | | 15 | | 16 | | 39 | | 112 |
| | + | 1000 | | 12 | | 18 | | 27 | | 33 | | 109 |
| | + | 2500 | | 10 | | 11 | | 19 | | 29 | | 92 |

Table 17

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 5A-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 36 | 23 | 18 | 15 | 12 | 16 | 35 | 47 | 161 | 152 |
| | + | 50000 | 17 | 17 | 29 | 26 | 18 | 26 | 59 | 41 | 174 | 162 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 643 | 618 | | | | | | | 662 | 678 |
| 9-Aminoacridine | - | 50.0 | | | 236 | 166 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 478 | 434 | 384 | 248 | | |
| 2-Anthramine | + | 2,5 | 164 | 246 | 43 | 93 | 696 | 715 | 832 | 951 | 1066 | 922 |
| RO 5A-1 | - | 10 | | 30 | | 14 | | 19 | | 27 | | 109 |
| | - | 50 | | 25 | | 14 | | 6 | | 25 | | 116 |
| | - | 100 | | 29 | | 18 | | 18 | | 40 | | 99 |
| | - | 500 | | 18 | | 18 | | 30 | | 43 | | 101 |
| | - | 1000 | | 29 | | 19 | | 13 | | 40 | | 91 |
| | - | 2500 | | 24 | | 18 | | 25 | | 41 | | 122 |
| | + | 10 | | 12 | | 21 | | 21 | | 57 | | 110 |
| | + | 50 | | 17 | | 17 | | 27 | | 55 | | 115 |
| | + | 100 | | 14 | | 25 | | 33 | | 55 | | 100 |
| | + | 500 | | 16 | | 37 | | 28 | | 52 | | 114 |
| | + | 1000 | | 12 | | 27 | | 28 | | 55 | | 104 |
| | + | 2500 | | 9 | | 29 | | 39 | | 50 | | 99 |

## Table 18

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 5A-2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 26 | 32 | 12 | 13 | 8 | 19 | 30 | 19 | 109 | 91 |
| | + | 50000 | 8 | 13 | 9 | 14 | 29 | 24 | 29 | 32 | 109 | 117 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 367 | 373 | | | | | | | 593 | 576 |
| 9-Aminoacridine | - | 50.0 | | | 307 | 294 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 700 | 433 | 332 | 381 | | |
| 2-Anthramine | + | 2.5 | 177 | 277 | 77 | 84 | 165 | 149 | 141 | 112 | 260 | 295 |
| RO 5A-2 | - | 10 | | 18 | | 9 | | 14 | | 21 | | 81 |
| | - | 50 | | 21 | | 13 | | 7 | | 18 | | 91 |
| | - | 100 | | 14 | | 5 | | 14 | | 16 | | 90 |
| | - | 500 | | 17 | | 12 | | 6 | | 20 | | 97 |
| | - | 1000 | | 17 | | 3 | | 9 | | 38 | | 92 |
| | - | 2500 | | 18 | | 8 | | 16 | | 78 | | 126 |
| | + | 10 | | 9 | | 16 | | 21 | | 28 | | 126 |
| | + | 50 | | 8 | | 24 | | 30 | | 65 | | 147 |
| | + | 100 | | 7 | | 28 | | 36 | | 68 | | 183 |
| | + | 500 | | 8 | | 51 | | 78 | | 99 | | 294 |
| | + | 1000 | | 12 | | 32 | | 77 | | 138 | | 307 |
| | + | 2500 | | 8 | | 41 | | 79 | | 115 | | 333 |

## Table 19

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 5A-2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 36 | 23 | 18 | 15 | 12 | 16 | 35 | 47 | 161 | 152 |
| | + | 50000 | 17 | 17 | 29 | 26 | 18 | 26 | 59 | 41 | 174 | 162 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 643 | 618 | | | | | | | 662 | 678 |
| 9-Aminoacridine | - | 50.0 | | | 236 | 166 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 478 | 434 | 384 | 248 | | |
| 2-Anthramine | + | 2.5 | 164 | 246 | 43 | 93 | 696 | 715 | 832 | 951 | 1066 | 922 |
| RO 5A-2 | - | 10 | | 32 | | 17 | | 9 | | 27 | | 85 |
| | - | 50 | | 27 | | 14 | | 15 | | 29 | | 78 |
| | - | 100 | | 21 | | 15 | | 12 | | 24 | | 81 |
| | - | 500 | | 33 | | 18 | | 12 | | 37 | | 90 |
| | - | 1000 | | 38 | | 20 | | 8 | | 24 | | 84 |
| | - | 2500 | | 26 | | 29 | | 11 | | 44 | | 89 |
| | + | 10 | | 8 | | 18 | | 32 | | 72 | | 99 |
| | + | 50 | | 19 | | 39 | | 44 | | 60 | | 112 |
| | + | 100 | | 15 | | 52 | | 45 | | 81 | | 127 |
| | + | 500 | | 13 | | 38 | | 66 | | 87 | | 175 |
| | + | 1000 | | 11 | | 36 | | 68 | | 100 | | 159 |
| | + | 2500 | | 9 | | 36 | | 63 | | 92 | | 117 |

## Table 20

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 5A-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 5A-3 | - | 10 | | 17 | | 7 | | 12 | | 33 | | 100 |
| | - | 50 | | 20 | | 5 | | 20 | | 38 | | 166 |
| | - | 100* | | 21 | | 7 | | 16 | | 49 | | 158 |
| | - | 500* | | 19 | | 7 | | 34 | | 178 | | 221 |
| | - | 1000* | | 17 | | 11 | | 49 | | 324 | | 210 |
| | - | 2500* | | 21 | | 12 | | 40 | | 199 | | 197 |
| | + | 10 | | 12 | | 20 | | 26 | | 63 | | 200 |
| | + | 50 | | 6 | | 19 | | 39 | | 100 | | 333 |
| | + | 100* | | 12 | | 23 | | 49 | | 110 | | 403 |
| | + | 500* | | 18 | | 30 | | 24 | | 103 | | 428 |
| | + | 1000* | | 8 | | 27 | | 60 | | 85 | | 441 |
| | + | 2500* | | 7 | | 28 | | 88 | | 138 | | 389 |

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*Formed precipitate when plated.

## Table 21

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 5A-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 36 | 23 | 18 | 15 | 12 | 16 | 35 | 47 | 161 | 152 |
| | + | 50000 | 17 | 17 | 29 | 26 | 18 | 26 | 59 | 41 | 174 | 162 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 643 | 618 | | | | | | | 662 | 678 |
| 9-Aminoacridine | - | 50.0 | | | 236 | 166 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 478 | 434 | 384 | 248 | | |
| 2-Anthramine | + | 2.5 | 164 | 246 | 43 | 93 | 696 | 715 | 832 | 951 | 1066 | 922 |
| RO 5A-3 | - | 10 | | 26 | | 12 | | 13 | | 44 | | 114 |
| | - | 50 | | 17 | | 16 | | 18 | | 34 | | 139 |
| | - | 100 | | 25 | | 9 | | 15 | | 67 | | 129 |
| | - | 500* | | 32 | | 16 | | 33 | | 128 | | 151 |
| | - | 1000* | | 25 | | 15 | | 36 | | 180 | | 173 |
| | - | 2500* | | 37 | | 18 | | 24 | | 182 | | 137 |
| | + | 10 | | 19 | | 20 | | 27 | | 75 | | 166 |
| | + | 50 | | 13 | | 28 | | 38 | | 98 | | 252 |
| | + | 100 | | 19 | | 22 | | 49 | | 121 | | 268 |
| | + | 500* | | 14 | | 29 | | 73 | | 138 | | 298 |
| | + | 1000* | | 14 | | 32 | | 61 | | 153 | | 266 |
| | + | 2500* | | 14 | | 30 | | 53 | | 127 | | 241 |

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*Formed precipitate when plated.

# Table 22

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 5A-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate<br>TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 5A-4 | - | 10 | | 13 | | 7 | | 13 | | 38 | | 108 |
| | - | 50 | | 15 | | 8 | | 7 | | 38 | | 104 |
| | - | 100* | | 28 | | 8 | | 14 | | 39 | | 120 |
| | - | 500* | | 19 | | 14 | | 24 | | 55 | | 152 |
| | - | 1000* | | 16 | | 20 | | 27 | | 80 | | 180 |
| | - | 2500* | | 16 | | 20 | | 32 | | 116 | | 218 |
| | + | 10 | | 9 | | 9 | | 19 | | 36 | | 126 |
| | + | 50 | | 5 | | 18 | | 20 | | 32 | | 147 |
| | + | 100* | | 6 | | 13 | | 30 | | 55 | | 146 |
| | + | 500* | | 12 | | 24 | | 69 | | 82 | | 219 |
| | + | 1000* | | 10 | | 21 | | 72 | | 89 | | 169 |
| | + | 2500* | | 13 | | 24 | | 82 | | 88 | | 197 |

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*Formed precipitate when plated.

## Table 23

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 5A-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 36 | 23 | 18 | 15 | 12 | 16 | 35 | 47 | 161 | 152 |
| | + | 50000 | 17 | 17 | 29 | 26 | 18 | 26 | 59 | 41 | 174 | 162 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 643 | 618 | | | | | | | 662 | 678 |
| 9-Aminoacridine | - | 50.0 | | | 236 | 166 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 478 | 434 | 384 | 248 | | |
| 2-Anthramine | + | 2.5 | 164 | 246 | 43 | 93 | 696 | 715 | 832 | 951 | 1066 | 922 |
| RO 5A-4 | - | 50 | | 19 | | 11 | | 18 | | 48 | | 153 |
| | - | 100* | | 29 | | 16 | | 19 | | 48 | | 125 |
| | - | 500* | | 26 | | 19 | | 19 | | 76 | | 134 |
| | - | 1000* | | 28 | | 17 | | 26 | | 96 | | 103 |
| | - | 1500* | | 22 | | 18 | | 31 | | 134 | | 151 |
| | - | 2500* | | 25 | | 20 | | 42 | | 130 | | 144 |
| | + | 50 | | 9 | | 35 | | 29 | | 45 | | 158 |
| | + | 100* | | 12 | | 22 | | 31 | | 65 | | 224 |
| | + | 500* | | 13 | | 36 | | 52 | | 105 | | 276 |
| | + | 1000* | | 17 | | 29 | | 58 | | 130 | | 282 |
| | + | 1500* | | 16 | | 29 | | 57 | | 136 | | 297 |
| | + | 2500* | | 15 | | 24 | | 63 | | 150 | | 328 |

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*Formed precipitate when plated.

## Table 24

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 5A-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 5A-5 | - | 10 | | 14 | | 9 | | 13 | | 32 | | 148 |
| | - | 50 | | 25 | | 15 | | 25 | | 50 | | 124 |
| | - | 100* | | 16 | | 9 | | 16 | | 54 | | 143 |
| | - | 500* | | 13 | | 17 | | 19 | | 73 | | 185 |
| | - | 1000* | | 24 | | 20 | | 29 | | 73 | | 162 |
| | - | 2500* | | 15 | | 21 | | 32 | | 46 | | 185 |
| | + | 10 | | 9 | | 20 | | 18 | | 48 | | 160 |
| | + | 50 | | 9 | | 19 | | 32 | | 63 | | 170 |
| | + | 100* | | 14 | | 36 | | 60 | | 96 | | 248 |
| | + | 500* | | 14 | | 22 | | 85 | | 135 | | 341 |
| | + | 1000* | | 14 | | 30 | | 76 | | 130 | | 322 |
| | + | 2500* | | 8 | | 37 | | 74 | | 124 | | 326 |

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*Formed precipitate when plated.

## Table 25

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 5A-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 36 | 23 | 18 | 15 | 12 | 16 | 35 | 47 | 161 | 152 |
| | + | 50000 | 17 | 17 | 29 | 26 | 18 | 26 | 59 | 41 | 174 | 162 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 643 | 618 | | | | | | | 662 | 678 |
| 9-Aminoacridine | - | 50.0 | | | 236 | 166 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 478 | 434 | 384 | 248 | | |
| 2-Anthramine | + | 2.5 | 164 | 246 | 43 | 93 | 696 | 715 | 832 | 951 | 1066 | 922 |
| RO 5A-5 | - | 10 | | 29 | | 16 | | 14 | | 42 | | 120 |
| | - | 50 | | 21 | | 18 | | 12 | | 57 | | 159 |
| | - | 100* | | 32 | | 11 | | 11 | | 51 | | 130 |
| | - | 250* | | 25 | | 11 | | 12 | | 51 | | 143 |
| | - | 500* | | 29 | | 7 | | 12 | | 59 | | 135 |
| | - | 750* | | 28 | | 9 | | 15 | | 68 | | 123 |
| | + | 10 | | 14 | | 17 | | 10 | | 52 | | 163 |
| | + | 50 | | 17 | | 29 | | 30 | | 60 | | 175 |
| | + | 100* | | 15 | | 16 | | 31 | | 84 | | 174 |
| | + | 250* | | 16 | | 25 | | 38 | | 96 | | 232 |
| | + | 500* | | 11 | | 30 | | 51 | | 100 | | 289 |
| | + | 750* | | 15 | | 21 | | 66 | | 86 | | 217 |

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*Formed precipitate when plated.

## Table 26

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 5A-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 5A-6 | - | 10 | | 24 | | 12 | | 13 | | 53 | | 166 |
| | - | 50 | | 24 | | 17 | | 9 | | 40 | | 125 |
| | - | 100* | | 13 | | 12 | | 16 | | 33 | | 179 |
| | - | 500* | | 21 | | 14 | | 26 | | 59 | | 189 |
| | - | 1000* | | 21 | | 12 | | 22 | | 56 | | 173 |
| | - | 2500* | | 28 | | 13 | | 20 | | 42 | | 199 |
| | + | 10 | | 13 | | 28 | | 20 | | 51 | | 141 |
| | + | 50 | | 12 | | 39 | | 36 | | 52 | | 159 |
| | + | 100* | | 12 | | 22 | | 49 | | 23 | | 160 |
| | + | 500* | | 12 | | 30 | | 82 | | 47 | | 219 |
| | + | 1000* | | 7 | | 27 | | 82 | | 50 | | 224 |
| | + | 2500* | | 11 | | 28 | | 97 | | 48 | | 237 |

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*Formed precipitate when plated.

Table 27

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 5A-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 36 | 23 | 18 | 15 | 12 | 16 | 35 | 47 | 161 | 152 |
| | + | 50000 | 17 | 17 | 29 | 26 | 18 | 26 | 59 | 41 | 174 | 162 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 643 | 618 | | | | | | | 662 | 678 |
| 9-Aminoacridine | - | 50.0 | | | 236 | 166 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 478 | 434 | 384 | 248 | | |
| 2-Anthramine | + | 2.5 | 164 | 246 | 43 | 93 | 696 | 715 | 832 | 951 | 1066 | 922 |
| RO 5A-6 | - | 10 | | 27 | | 15 | | 19 | | 39 | | 142 |
| | - | 50* | | 30 | | 11 | | 10 | | 48 | | 152 |
| | - | 100* | | 28 | | 17 | | 10 | | 52 | | 158 |
| | - | 500* | | 34 | | 10 | | 14 | | 55 | | 168 |
| | - | 1000* | | 38 | | 18 | | 7 | | 57 | | 169 |
| | - | 2500* | | 33 | | 12 | | 17 | | 61 | | 152 |
| | + | 10 | | 13 | | 20 | | 21 | | 47 | | 159 |
| | + | 50* | | 12 | | 23 | | 18 | | 56 | | 181 |
| | + | 100* | | 10 | | 16 | | 24 | | 74 | | 194 |
| | + | 500* | | 16 | | 23 | | 31 | | 91 | | 232 |
| | + | 1000* | | 14 | | 24 | | 34 | | 99 | | 209 |
| | + | 2500* | | 15 | | 26 | | 45 | | 106 | | 224 |

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*Formed precipitate when plated.

## Table 28

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 5A-7

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Negative control** | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| **Positive controls** | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 5A-7 | - | 1 | | 15 | | 12 | | 14 | | 35 | | 146 |
| | - | 5 | | 18 | | 7 | | 10 | | 36 | | 134 |
| | - | 10 | | 24 | | 7 | | 9 | | 43 | | 148 |
| | - | 50 | | 25 | | 11 | | 16 | | 40 | | 125 |
| | - | 100* | | 29 | | 11 | | 19 | | 53 | | 171 |
| | - | 500* | | 24 | | 9 | | 23 | | 42 | | 182 |
| | + | 1 | | 14 | | 27 | | 13 | | 58 | | 171 |
| | + | 5 | | 13 | | 22 | | 18 | | 43 | | 152 |
| | + | 10 | | 13 | | 22 | | 29 | | 62 | | 148 |
| | + | 50 | | 9 | | 32 | | 31 | | 66 | | 185 |
| | + | 100* | | 18 | | 31 | | 41 | | 68 | | 251 |
| | + | 500* | | 12 | | 44 | | 87 | | 116 | | 297 |

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[*] Formed precipitate when plated.

Table 29

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 12A-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 26 | 32 | 12 | 13 | 8 | 19 | 30 | 19 | 109 | 91 |
| | + | 50000 | 8 | 13 | 9 | 14 | 29 | 24 | 29 | 32 | 109 | 117 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 367 | 373 | | | | | | | 593 | 576 |
| 9-Aminoacridine | - | 50.0 | | | 307 | 294 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 700 | 433 | 332 | 381 | | |
| 2-Anthramine | + | 2.5 | 177 | 277 | 77 | 84 | 165 | 149 | 141 | 112 | 260 | 295 |
| RO 12A-1 | - | 10 | | 20 | | 5 | | 9 | | 28 | | 127 |
| | - | 50 | | 18 | | 7 | | 6 | | 30 | | 91 |
| | - | 100 | | 13 | | 7 | | 8 | | 26 | | 87 |
| | - | 500 | | 28 | | 7 | | 12 | | 20 | | 96 |
| | - | 1000 | | 24 | | 8 | | 15 | | 33 | | 75 |
| | - | 2500 | | 12 | | 12 | | 25 | | 34 | | 98 |
| | + | 10 | | 6 | | 7 | | 16 | | 33 | | 81 |
| | + | 50 | | 16 | | 16 | | 21 | | 36 | | 91 |
| | + | 100 | | 5 | | 17 | | 17 | | 36 | | 103 |
| | + | 500 | | 8 | | 16 | | 16 | | 44 | | 103 |
| | + | 1000 | | 12 | | 13 | | 38 | | 53 | | 112 |
| | + | 2500 | | 9 | | 18 | | 38 | | 51 | | 105 |

## Table 30

### IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 12A-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 20 | 25 | 17 | 15 | 14 | 11 | 32 | 33 | 130 | 152 |
| | + | 50000 | 12 | 11 | 17 | 21 | 30 | 18 | 54 | 41 | 152 | 159 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 544 | 545 | | | | | | | 647 | 671 |
| 9-Aminoacridine | - | 50.0 | | | 234 | 163 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 590 | 663 | 336 | 318 | | |
| 2-Anthramine | + | 2.5 | 105 | 114 | 111 | 41 | 380 | 411 | 916 | 764 | 996 | 809 |
| RO 12A-1 | - | 10 | | 21 | | 15 | | 18 | | 39 | | 151 |
| | - | 50 | | 26 | | 15 | | 16 | | 27 | | 154 |
| | - | 100 | | 29 | | 8 | | 14 | | 31 | | 130 |
| | - | 500 | | 21 | | 15 | | 18 | | 41 | | 143 |
| | - | 1000 | | 29 | | 17 | | 17 | | 36 | | 136 |
| | - | 2500 | | 31 | | 24 | | 12 | | 48 | | 161 |
| | + | 10 | | 14 | | 17 | | 18 | | 55 | | 162 |
| | + | 50 | | 14 | | 29 | | 25 | | 51 | | 160 |
| | + | 100 | | 13 | | 20 | | 20 | | 37 | | 127 |
| | + | 500 | | 17 | | 29 | | 27 | | 58 | | 211 |
| | + | 1000 | | 18 | | 18 | | 33 | | 51 | | 175 |
| | + | 2500 | | 9 | | 27 | | 29 | | 40 | | 176 |

## Table 31

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 12A-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1538 | | | TA98 | | | TA100 | | |
| Negative control | | | | | | | | | | | |
| Dioxane | + | 50,000 | 31 | 33 | 61 | 68 | 50 | 56 | 161 | 126 | 174 |
| Positive controls | | | | | | | | | | | |
| Sodium azide | - | 1.0 | | | | | | | | 446 | 435 |
| 2-Nitrofluorene | - | 5.0 | | 539 | 498 | | 356 | 661 | | | |
| 2-Anthramine | + | 2.5 | | 677 | 631 | | 482 | 497 | | 890 | 1211 |
| RO 12A-1 | + | 10 | | | | | 13 | 15 | | 43 | 39 |
| | + | 50 | | | | | 18 | 16 | | 37 | 32 |
| | + | 100 | | | | | 21 | 17 | | 40 | 51 |
| | + | 250 | | | | | 20 | 7 | | 51 | 63 |
| | + | 500 | | | | | 19 | 15 | | 45 | 66 |
| | + | 750 | | | | | 16 | 30 | | 42 | 45 |
| | + | 1000 | | | | | 14 | 25 | | 37 | 49 |

Table 32

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 12A-2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | TA1535 |  | TA1537 |  | TA1538 |  | TA98 |  | TA100 |  |
| Negative control |  |  |  |  |  |  |  |  |  |  |  |  |
| Dioxane | - | 50000 | 26 | 32 | 12 | 13 | 8 | 19 | 30 | 19 | 109 | 91 |
|  | + | 50000 | 8 | 13 | 9 | 14 | 29 | 24 | 29 | 32 | 109 | 117 |
| Positive controls |  |  |  |  |  |  |  |  |  |  |  |  |
| Sodium azide | - | 1.0 | 367 | 373 |  |  |  |  |  |  | 593 | 576 |
| 9-Aminoacridine | - | 50.0 |  |  | 307 | 294 |  |  |  |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  |  |  | 700 | 433 | 332 | 381 |  |  |
| 2-Anthramine | + | 2.5 | 177 | 277 | 77 | 84 | 165 | 149 | 141 | 112 | 260 | 295 |
| RO 12A-2 | - | 10 |  | 29 |  | 13 |  | 13 |  | 17 |  | 117 |
|  | - | 50 |  | 17 |  | 6 |  | 27 |  | 30 |  | 80 |
|  | - | 100 |  | 16 |  | 15 |  | 18 |  | 28 |  | 89 |
|  | - | 500 |  | 12 |  | 3 |  | 18 |  | 16 |  | 61 |
|  | - | 1000 |  | 17 |  | 13 |  | 9 |  | 17 |  | 80 |
|  | - | 2500 |  | 28 |  | 16 |  | 14 |  | 22 |  | 93 |
|  | + | 10 |  | 9 |  | 9 |  | 12 |  | 24 |  | 96 |
|  | + | 50 |  | 8 |  | 9 |  | 19 |  | 32 |  | 110 |
|  | + | 100 |  | 13 |  | 17 |  | 39 |  | 60 |  | 195 |
|  | + | 500 |  | 12 |  | 19 |  | 75 |  | 79 |  | 203 |
|  | + | 1000 |  | 9 |  | 12 |  | 43 |  | 54 |  | 225 |
|  | + | 2500 |  | 12 |  | 13 |  | 50 |  | 74 |  | 234 |

# Table 33

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 12A-2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | TA1535 |  | TA1537 |  | TA1538 |  | TA98 |  | TA100 |  |
| Negative control |  |  |  |  |  |  |  |  |  |  |  |  |
| Dioxane | - | 50000 | 20 | 25 | 17 | 15 | 14 | 11 | 32 | 33 | 130 | 152 |
|  | + | 50000 | 12 | 11 | 17 | 21 | 30 | 18 | 54 | 41 | 152 | 159 |
| Positive controls |  |  |  |  |  |  |  |  |  |  |  |  |
| Sodium azide | - | 1.0 | 544 | 545 |  |  |  |  |  |  | 647 | 671 |
| 9-Aminoacridine | - | 50.0 |  |  | 234 | 163 |  |  |  |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  |  |  | 590 | 663 | 336 | 318 |  |  |
| 2-Anthramine | + | 2.5 | 105 | 114 | 111 | 41 | 380 | 411 | 916 | 764 | 996 | 809 |
| RO 12A-2 | - | 10 |  | 25 |  | 13 |  | 15 |  | 32 |  | 146 |
|  | - | 50 |  | 25 |  | 14 |  | 9 |  | 38 |  | 139 |
|  | - | 100 |  | 24 |  | 5 |  | 8 |  | 37 |  | 148 |
|  | - | 500 |  | 17 |  | 24 |  | 17 |  | 49 |  | 147 |
|  | - | 1000 |  | 27 |  | 19 |  | 18 |  | 43 |  | 142 |
|  | - | 2500 |  | 20 |  | C* |  | 13 |  | 43 |  | 164 |
|  | + | 10 |  | 19 |  | 16 |  | 20 |  | 33 |  | 166 |
|  | + | 50 |  | 13 |  | 21 |  | 21 |  | 44 |  | 212 |
|  | + | 100 |  | 12 |  | 22 |  | 27 |  | 55 |  | 217 |
|  | + | 500 |  | 9 |  | 29 |  | 26 |  | 67 |  | 262 |
|  | + | 1000 |  | 13 |  | 38 |  | 25 |  | 85 |  | 304 |
|  | + | 2500 |  | 17 |  | 21 |  | 28 |  | 65 |  | 320 |

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*C, contaminated.

Table 34

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 12A-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 12A-3 | - | 10 | | 15 | | 13 | | 7 | | 52 | | 131 |
| | - | 50 | | 24 | | 15 | | 24 | | 41 | | 165 |
| | - | 100* | | 17 | | 16 | | 15 | | 55 | | 181 |
| | - | 500* | | 27 | | 27 | | 15 | | 43 | | 198 |
| | - | 1000* | | 26 | | 15 | | 17 | | 68 | | 167 |
| | - | 2500* | | 25 | | 16 | | 23 | | 41 | | 164 |
| | + | 10 | | 9 | | 28 | | 26 | | 43 | | 139 |
| | + | 50 | | 5 | | 33 | | 27 | | 55 | | 184 |
| | + | 100* | | 12 | | 25 | | 28 | | 45 | | 238 |
| | + | 500* | | 12 | | 25 | | 43 | | 100 | | 293 |
| | + | 1000* | | 18 | | 27 | | 90 | | 102 | | 380 |
| | + | 2500* | | 11 | | 27 | | 60 | | 114 | | 431 |

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*Formed precipitate when plated.

## Table 35

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 12A-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 30 | 30 | 6 | 13 | 13 | 17 | 32 | 30 | 128 | 124 |
| | + | 50000 | 17 | 20 | 12 | 26 | 28 | 20 | 57 | 43 | 117 | 110 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 450 | 536 | | | | | | | 541 | 466 |
| 9-Aminoacridine | - | 50.0 | | | 186 | 219 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 746 | 907 | 467 | 458 | | |
| 2-Anthramine | + | 2.5 | 519 | 446 | 197 | 196 | 462 | 550 | 1972 | 2100 | 2319 | 2142 |
| RO 12A-3 | - | 10 | | 19 | | 20 | | 14 | | 45 | | 113 |
| | - | 50 | | 18 | | 14 | | 14 | | 37 | | 101 |
| | - | 100* | | 28 | | 20 | | 18 | | 31 | | 114 |
| | - | 500* | | 20 | | 16 | | 12 | | 38 | | 157 |
| | - | 1000* | | 26 | | 20 | | 21 | | 40 | | 130 |
| | - | 2500* | | 39 | | 11 | | 20 | | 44 | | 133 |
| | + | 10 | | 19 | | 18 | | 33 | | 41 | | 117 |
| | + | 50 | | 16 | | 17 | | 32 | | 61 | | 127 |
| | + | 100* | | 8 | | 18 | | 37 | | 64 | | 163 |
| | + | 500* | | 15 | | 23 | | 38 | | 71 | | 251 |
| | + | 1000* | | 6 | | 29 | | 42 | | 62 | | 274 |
| | + | 2500* | | 19 | | 23 | | 57 | | 63 | | 284 |

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*Formed precipitate when plated.

## Table 36

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 12A-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 12A-4 | - | 10 | | 25 | | 12 | | 24 | | 44 | | 152 |
| | - | 50 | | 31 | | 19 | | 20 | | 42 | | 178 |
| | - | 100 | | 34 | | 12 | | 23 | | 54 | | 143 |
| | - | 500 * | | 43 | | 25 | | 24 | | 45 | | 179 |
| | - | 1000 * | | 33 | | 22 | | 29 | | 67 | | 160 |
| | - | 2500 * | | 25 | | 16 | | 36 | | 59 | | 192 |
| | + | 10 | | 8 | | 37 | | 24 | | 55 | | 177 |
| | + | 50 | | 10 | | 21 | | 16 | | 53 | | 140 |
| | + | 100 | | 12 | | 38 | | 20 | | 58 | | 178 |
| | + | 500 * | | 8 | | 34 | | 33 | | 74 | | 190 |
| | + | 1000 * | | 9 | | 27 | | 47 | | 74 | | 240 |
| | + | 2500 * | | 10 | | 26 | | 48 | | 92 | | 251 |

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*Formed precipitate when plated.

## Table 37

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 12A-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 30 | 30 | 6 | 13 | 13 | 17 | 32 | 30 | 128 | 124 |
| | + | 50000 | 17 | 20 | 12 | 26 | 28 | 20 | 57 | 43 | 117 | 110 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 450 | 536 | | | | | | | 541 | 466 |
| 9-Aminoacridine | - | 50.0 | | | 186 | 219 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 746 | 907 | 467 | 458 | | |
| 2-Anthramine | + | 2.5 | 519 | 446 | 197 | 196 | 462 | 550 | 1972 | 2100 | 2319 | 2142 |
| RO 12A-4 | - | 10 | | 18 | | 6 | | 22 | | 25 | | 86 |
| | - | 50 | | 16 | | 15 | | 12 | | 44 | | 86 |
| | - | 100* | | 22 | | 10 | | 13 | | 38 | | 120 |
| | - | 500* | | 26 | | 9 | | 16 | | 23 | | 111 |
| | - | 1000* | | 25 | | 11 | | 11 | | 42 | | 100 |
| | - | 2500* | | 13 | | 17 | | 17 | | 57 | | 109 |
| | + | 10 | | 13 | | 14 | | 28 | | 56 | | 126 |
| | + | 50 | | 17 | | 20 | | 19 | | 60 | | 109 |
| | + | 100* | | 14 | | 19 | | 33 | | 59 | | 126 |
| | + | 500* | | 13 | | 24 | | 34 | | 47 | | 136 |
| | + | 1000* | | 9 | | 28 | | 33 | | 69 | | 152 |
| | + | 2500* | | 11 | | 29 | | 41 | | 83 | | 235 |

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*Formed precipitate when plated.

## Table 38

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
## RO 12A-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1538 | | | TA98 | | | TA100 | | |
| Negative control | | | | | | | | | | | |
| Dioxane | + | 50,000 | 31 | 33 | 61 | 68 | 50 | 56 | 161 | 126 | 174 |
| Positive controls | | | | | | | | | | | |
| Sodium azide | - | 1.0 | | | | | | | | 446 | 435 |
| 2-Nitrofluorene | - | 5.0 | | 539 | 498 | | 356 | 661 | | | |
| 2-Anthramine | + | 2.5 | | 677 | 631 | | 482 | 497 | | 890 | 1211 |
| RO 12A-4 | + | 100 | | | | | | | | 177 | 156 |
| | + | 250 | | | | | | | | 161 | 159 |
| | + | 500 | | | | | | | | 190 | 180 |
| | + | 1000 | | | | | | | | 220 | 205 |
| | + | 1500 | | | | | | | | 226 | 186 |
| | + | 2500 | | | | | | | | 201 | 225 |

## Table 39

### IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 12A-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 12A-5 | - | 10 | | 28 | | 19 | | 28 | | 31 | | 141 |
| | - | 50 | | 33 | | 14 | | 10 | | 39 | | 135 |
| | - | 100 | | 36 | | 14 | | 19 | | 51 | | 175 |
| | - | 500* | | 42 | | 17 | | 15 | | 41 | | 174 |
| | - | 1000* | | 42 | | 15 | | 26 | | 57 | | 207 |
| | - | 2500* | | 48 | | 11 | | 28 | | 48 | | 208 |
| | + | 10 | | 12 | | 22 | | 26 | | 40 | | 167 |
| | + | 50 | | 5 | | 41 | | 25 | | 24 | | 162 |
| | + | 100 | | 11 | | 18 | | 32 | | 55 | | 196 |
| | + | 500* | | 15 | | 27 | | 44 | | 85 | | 274 |
| | + | 1000* | | 12 | | 27 | | 56 | | 98 | | 309 |
| | + | 2500* | | 20 | | 25 | | 70 | | 86 | | 295 |

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*Formed precipitate when plated.

Table 40

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 12A-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 20 | 25 | 17 | 15 | 14 | 11 | 32 | 33 | 130 | 152 |
| | + | 50000 | 12 | 11 | 17 | 21 | 30 | 18 | 54 | 41 | 152 | 159 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 544 | 545 | | | | | | | 647 | 671 |
| 9-Aminoacridine | - | 50.0 | | | 234 | 163 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 590 | 663 | 336 | 318 | | |
| 2-Anthramine | + | 2.5 | 105 | 114 | 111 | 41 | 380 | 411 | 916 | 764 | 996 | 809 |
| RO 12A-5 | - | 10 | | 25 | | 14 | | 10 | | 42 | | 138 |
| | - | 50 | | 18 | | 8 | | 8 | | C[†] | | 143 |
| | - | 100 | | 26 | | 15 | | 11 | | 36 | | 135 |
| | - | 500* | | 31 | | 19 | | 10 | | 44 | | 138 |
| | - | 1000* | | 22 | | 10 | | 12 | | 44 | | 162 |
| | - | 2500* | | 23 | | 9 | | 13 | | 40 | | 151 |
| | + | 10 | | 4 | | 13 | | 26 | | 36 | | 141 |
| | + | 50 | | 9 | | 19 | | 26 | | 51 | | 148 |
| | + | 100 | | 15 | | 19 | | 20 | | 48 | | 154 |
| | + | 500* | | 12 | | 20 | | 49 | | 70 | | 215 |
| | + | 1000* | | 7 | | 17 | | 46 | | 81 | | 270 |
| | + | 2500* | | 10 | | 18 | | 52 | | 83 | | 263 |

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[*] Formed precipitate when plated.

[†] C, contaminated.

## Table 41

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 12A-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 12A-6 | - | 10 | | 24 | | 15 | | 21 | | 39 | | 122 |
| | - | 50 | | 27 | | 11 | | 16 | | 34 | | 176 |
| | - | 100* | | 22 | | 14 | | 19 | | 50 | | 153 |
| | - | 500* | | 18 | | 19 | | 14 | | 34 | | 141 |
| | - | 1000* | | 21 | | 17 | | 15 | | 46 | | 145 |
| | - | 2500* | | 24 | | 27 | | 20 | | 35 | | 163 |
| | + | 10 | | 7 | | 27 | | 26 | | 60 | | 147 |
| | + | 50 | | 8 | | 39 | | 23 | | 53 | | 172 |
| | + | 100* | | 16 | | 32 | | 24 | | 51 | | 162 |
| | + | 500* | | 12 | | 19 | | 29 | | 49 | | 159 |
| | + | 1000* | | 9 | | 33 | | 14 | | 54 | | 156 |
| | + | 2500* | | 10 | | 28 | | 47 | | 69 | | 196 |

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*Formed precipitate when plated.

## Table 42

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 12A-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 20 | 25 | 17 | 15 | 14 | 11 | 32 | 33 | 130 | 152 |
| | + | 50000 | 12 | 11 | 17 | 21 | 30 | 18 | 54 | 41 | 152 | 159 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 544 | 545 | | | | | | | 647 | 671 |
| 9-Aminoacridine | - | 50.0 | | | 234 | 163 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 590 | 663 | 336 | 318 | | |
| 2-Anthramine | + | 2.5 | 105 | 114 | 111 | 41 | 380 | 411 | 916 | 764 | 996 | 809 |
| RO 12A-6 | - | 10 | | 32 | | 16 | | 15 | | 41 | | 159 |
| | - | 50* | | 16 | | 12 | | 12 | | 31 | | 130 |
| | - | 100* | | 28 | | 20 | | 12 | | 36 | | 147 |
| | - | 500* | | 24 | | 12 | | 10 | | 37 | | 183 |
| | - | 1000* | | 31 | | 11 | | 15 | | 31 | | 153 |
| | - | 2500* | | 29 | | 15 | | 12 | | 35 | | 146 |
| | + | 10 | | 10 | | 12 | | 29 | | 39 | | 173 |
| | + | 50* | | 9 | | 17 | | 18 | | 37 | | 167 |
| | + | 100* | | 11 | | 14 | | 18 | | 42 | | 187 |
| | + | 500* | | C† | | 20 | | 24 | | 53 | | 195 |
| | + | 1000* | | 12 | | 28 | | 32 | | 65 | | 210 |
| | + | 2500* | | 6 | | 23 | | 40 | | 69 | | 217 |

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*Formed precipitate when plated.

†C, contaminated.

Table 43

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 12A-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1538 | | | TA98 | | | TA100 | | |
| Negative control | | | | | | | | | | | |
| Dioxane | + | 50,000 | 31 | 33 | 61 | 68 | 50 | 56 | 161 | 126 | 174 |
| Positive controls | | | | | | | | | | | |
| Sodium azide | - | 1.0 | | | | | | | | 446 | 435 |
| 2-Nitrofluorene | - | 5.0 | | 539 | 498 | | 356 | 661 | | | |
| 2-Anthramine | + | 2.5 | | 677 | 631 | | 482 | 497 | | 890 | 1211 |
| RO 12A-6 | + | 100 | | 40 | 22 | | 62 | 58 | | 146 | 157 |
| | + | 500 | | 33 | 39 | | 54 | 58 | | 185 | 179 |
| | + | 1000 | | 45 | 31 | | 57 | 77 | | 229 | 195 |
| | + | 1500 | | 44 | 64 | | 67 | 49 | | 238 | 217 |
| | + | 2500 | | 39 | 39 | | 73 | NT* | | 246 | 221 |

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*NT, not tested.

## Table 44

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 12A-7

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 28 | 37 | 7 | 8 | 18 | 12 | 32 | 44 | 151 | 142 |
| | + | 50000 | 12 | 14 | 30 | 33 | 16 | 20 | 44 | 49 | 136 | 126 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 347 | 390 | | | | | | | 562 | 592 |
| 9-Aminoacridine | - | 50.0 | | | 328 | 232 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 699 | 727 | 463 | 408 | | |
| 2-Anthramine | + | 2.5 | 236 | 408 | 172 | 171 | 478 | 506 | 543 | 541 | 722 | 906 |
| RO 12A-7 | - | 1 | | 25 | | 8 | | 18 | | 40 | | 146 |
| | - | 5 | | 26 | | 5 | | 24 | | 36 | | 139 |
| | - | 10* | | 39 | | 17 | | 18 | | 40 | | 151 |
| | - | 50* | | 43 | | 32 | | 16 | | 35 | | 175 |
| | - | 100* | | 27 | | 15 | | 24 | | 30 | | 157 |
| | - | 500* | | 28 | | 29 | | 25 | | 34 | | 145 |
| | + | 1 | | 13 | | 45 | | 27 | | 37 | | 162 |
| | + | 5 | | 9 | | 43 | | 26 | | 42 | | 149 |
| | + | 10* | | 14 | | 27 | | 26 | | 48 | | 162 |
| | + | 50* | | 11 | | 35 | | 35 | | 33 | | 171 |
| | + | 100* | | 12 | | 31 | | 27 | | 40 | | 127 |
| | + | 500* | | 13 | | 40 | | 58 | | 56 | | 188 |

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*Formed precipitate when plated.

## Table 45

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 12A-7

| Compound | Metabolic Activation | Amount of Compound Added per Plate | Histidine Revertants per Plate<br>TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 μg | 30 | 30 | 6 | 13 | 13 | 17 | 32 | 30 | 128 | 124 |
| | + | 50000 | 17 | 20 | 12 | 26 | 28 | 20 | 57 | 43 | 117 | 110 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 450 | 536 | | | | | | | 541 | 466 |
| 9-Aminoacridine | - | 50.0 | | | 186 | 219 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 746 | 907 | 467 | 458 | | |
| 2-Anthramine | + | 2.5 | 519 | 446 | 197 | 196 | 462 | 550 | 1972 | 2100 | 2319 | 2142 |
| RO 12A-7 | + | 10 μl* | | | | | | | | | | 121 |
| | + | 20 μl* | | | | | | | | | | 99 |
| | + | 30 μl* | | | | | | | | | | 127 |
| | + | 40 μl* | | | | | | | | | | 164 |
| | + | 50 μl* | | | | | | | | | | 185 |

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*Formed precipitate when plated.

# Table 46

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 14-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | TA1535 |  | TA1537 |  | TA1538 |  | TA98 |  | TA100 |  |
| Negative control |  |  |  |  |  |  |  |  |  |  |  |  |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
|  | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls |  |  |  |  |  |  |  |  |  |  |  |  |
| Sodium azide | - | 1.0 | 345 | 378 |  |  |  |  |  |  | 387 | 403 |
| 9-Aminoacridine | - | 50.0 |  |  | 467 | 307 |  |  |  |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  |  |  | 903 | 944 | 622 | 649 |  |  |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 14-1 | - | 10 |  | 18 |  | 15 |  | 15 |  | 40 |  | 146 |
|  | - | 50 |  | 8 |  | 9 |  | 17 |  | 42 |  | 153 |
|  | - | 100 |  | 33 |  | 18 |  | 9 |  | 56 |  | 161 |
|  | - | 500 |  | 14 |  | 9 |  | 21 |  | 42 |  | 153 |
|  | - | 1000 |  | 18 |  | 11 |  | 15 |  | 51 |  | 134 |
|  | - | 2500 |  | 17 |  | 16 |  | 12 |  | 43 |  | 99 |
|  | + | 10 |  | 17 |  | 24 |  | 17 |  | 41 |  | 138 |
|  | + | 50 |  | 6 |  | 28 |  | 18 |  | 44 |  | 162 |
|  | + | 100 |  | 12 |  | 16 |  | 27 |  | 33 |  | 152 |
|  | + | 500 |  | 16 |  | 29 |  | 24 |  | 30 |  | 169 |
|  | + | 1000 |  | 17 |  | 16 |  | 27 |  | 42 |  | 179 |
|  | + | 2500 |  | 15 |  | 18 |  | 28 |  | 42 |  | 186 |

## Table 47

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 14-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 26 | 16 | 11 | 16 | 14 | 9 | 45 | 40 | 104 | 137 |
| | + | 50000 | 19 | 17 | 15 | 14 | 21 | 16 | 30 | 33 | 130 | 134 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 324 | 373 | | | | | | | 672 | 642 |
| 9-Aminoacridine | - | 50.0 | | | 588 | 703 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 883 | 669 | 456 | 440 | | |
| 2-Anthramine | + | 2.5 | 178 | 167 | 68 | 72 | 316 | 334 | 709 | 701 | 691 | 714 |
| RO 14-1 | - | 10 | | 26 | | 9 | | 6 | | 26 | | 124 |
| | - | 50 | | 25 | | 8 | | 8 | | 32 | | 114 |
| | - | 100 | | 22 | | 7 | | 9 | | 33 | | 109 |
| | - | 500 | | 26 | | 4 | | 17 | | 28 | | 113 |
| | - | 1000 | | 15 | | 4 | | 9 | | 36 | | 92 |
| | - | 2500 | | 17 | | 12 | | 9 | | 27 | | 117 |
| | + | 10 | | 12 | | 13 | | 28 | | 54 | | 112 |
| | + | 50 | | 14 | | 16 | | 20 | | 37 | | 105 |
| | + | 100 | | 15 | | 12 | | 28 | | 42 | | 98 |
| | + | 500 | | 15 | | 18 | | 21 | | 38 | | 113 |
| | + | 1000 | | 7 | | 13 | | 21 | | 57 | | 128 |
| | + | 2500 | | 19 | | 17 | | 28 | | 40 | | 112 |

## Table 48

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 14-2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 14-2 | - | 10 | | 27 | | 12 | | 8 | | 32 | | 117 |
| | - | 50 | | 13 | | 19 | | 12 | | 24 | | 113 |
| | - | 100 | | 19 | | 13 | | 4 | | 24 | | 103 |
| | - | 500 | | 15 | | 17 | | 8 | | 29 | | 114 |
| | - | 1000 | | 16 | | 12 | | 9 | | 40 | | 110 |
| | - | 2500 | | 12 | | 14 | | 12 | | 48 | | 105 |
| | + | 10 | | 13 | | 18 | | 28 | | 48 | | 175 |
| | + | 50 | | 6 | | 24 | | 24 | | 36 | | 160 |
| | + | 100 | | 9 | | 20 | | 25 | | 41 | | 164 |
| | + | 500 | | 13 | | 21 | | 32 | | 63 | | 226 |
| | + | 1000 | | 7 | | 20 | | 33 | | 91 | | 207 |
| | + | 2500 | | 13 | | 30 | | 39 | | 86 | | 191 |

### Table 49

### IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 14-2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | TA1535 |  | TA1537 |  | TA1538 |  | TA98 |  | TA100 |  |
| Negative control |  |  |  |  |  |  |  |  |  |  |  |  |
| Dioxane | - | 50000 | 26 | 16 | 11 | 16 | 14 | 9 | 45 | 40 | 104 | 137 |
|  | + | 50000 | 19 | 17 | 15 | 14 | 21 | 16 | 30 | 33 | 130 | 134 |
| Positive controls |  |  |  |  |  |  |  |  |  |  |  |  |
| Sodium azide | - | 1.0 | 324 | 373 |  |  |  |  |  |  | 672 | 642 |
| 9-Aminoacridine | - | 50.0 |  |  | 588 | 703 |  |  |  |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  |  |  | 883 | 669 | 456 | 440 |  |  |
| 2-Anthramine | + | 2.5 | 178 | 167 | 68 | 72 | 316 | 334 | 709 | 701 | 691 | 714 |
| RO 14-2 | - | 50 |  | 31 |  | 14 |  | 9 |  | 25 |  | 86 |
|  | - | 100 |  | 29 |  | 6 |  | 13 |  | 25 |  | 72 |
|  | - | 500 |  | 24 |  | 17 |  | 13 |  | 33 |  | 93 |
|  | - | 750 |  | 21 |  | 16 |  | 15 |  | 37 |  | 86 |
|  | - | 1000 |  | 16 |  | 18 |  | 16 |  | 49 |  | 106 |
|  | - | 1500 |  | 14 |  | 21 |  | 12 |  | 30 |  | 90 |
|  | + | 50 |  | 15 |  | 14 |  | 24 |  | 53 |  | 166 |
|  | + | 100 |  | 8 |  | 14 |  | 45 |  | 54 |  | 168 |
|  | + | 500 |  | 14 |  | 21 |  | 68 |  | 128 |  | 271 |
|  | + | 750 |  | 14 |  | 16 |  | 76 |  | 96 |  | 244 |
|  | + | 1000 |  | 9 |  | 24 |  | 63 |  | 91 |  | 200 |
|  | + | 1500 |  | 16 |  | 32 |  | 75 |  | 85 |  | 219 |

## Table 50

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 14-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | TA1535 |  | TA1537 |  | TA1538 |  | TA98 |  | TA100 |  |
| Negative control |  |  |  |  |  |  |  |  |  |  |  |  |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
|  | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls |  |  |  |  |  |  |  |  |  |  |  |  |
| Sodium azide | - | 1.0 | 345 | 378 |  |  |  |  |  |  | 387 | 403 |
| 9-Aminoacridine | - | 50.0 |  |  | 467 | 307 |  |  |  |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  |  |  | 903 | 944 | 622 | 649 |  |  |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 14-3 | - | 10 |  | 19 |  | 14 |  | 12 |  | 27 |  | 142 |
|  | - | 50 |  | 20 |  | 13 |  | 14 |  | 52 |  | 161 |
|  | - | 100 |  | 28 |  | 34 |  | 17 |  | 53 |  | 198 |
|  | - | 500* |  | 23 |  | 45 |  | 25 |  | 142 |  | 257 |
|  | - | 1000* |  | 20 |  | 57 |  | 60 |  | 214 |  | 284 |
|  | - | 2500* |  | 27 |  | 47 |  | 47 |  | 179 |  | 222 |
|  | + | 10 |  | 8 |  | 11 |  | 22 |  | 42 |  | 151 |
|  | + | 50 |  | 11 |  | 18 |  | 28 |  | 54 |  | 232 |
|  | + | 100 |  | 11 |  | 24 |  | 41 |  | 42 |  | 238 |
|  | + | 500* |  | 13 |  | 26 |  | 47 |  | 95 |  | 295 |
|  | + | 1000* |  | 9 |  | 26 |  | 53 |  | 98 |  | 341 |
|  | + | 2500* |  | 14 |  | 31 |  | 62 |  | 103 |  | 304 |

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*Formed precipitate when plated.

## Table 51

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 14-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 26 | 16 | 11 | 16 | 14 | 9 | 45 | 40 | 104 | 137 |
| | + | 50000 | 19 | 17 | 15 | 14 | 21 | 16 | 30 | 33 | 130 | 134 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 324 | 373 | | | | | | | 672 | 642 |
| 9-Aminoacridine | - | 50.0 | | | 588 | 703 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 883 | 669 | 456 | 440 | | |
| 2-Anthramine | + | 2.5 | 178 | 167 | 68 | 72 | 316 | 334 | 709 | 701 | 691 | 714 |
| RO 14-3 | - | 10 | | 22 | | 9 | | 14 | | 27 | | 111 |
| | - | 50 | | 33 | | 16 | | 14 | | 50 | | 121 |
| | - | 100 | | 28 | | 21 | | 26 | | 60 | | 129 |
| | - | 500* | | 28 | | 18 | | 41 | | 107 | | 134 |
| | - | 1000* | | 18 | | 26 | | 42 | | 277 | | 163 |
| | - | 1500* | | 23 | | 50 | | 36 | | 228 | | 194 |
| | + | 10 | | 16 | | 18 | | 20 | | 32 | | 141 |
| | + | 50 | | 9 | | 18 | | 32 | | 71 | | 166 |
| | + | 100 | | 20 | | 29 | | 50 | | 87 | | 239 |
| | + | 500* | | 12 | | 24 | | 65 | | 159 | | 275 |
| | + | 1000* | | 16 | | 36 | | 72 | | 209 | | 321 |
| | + | 1500* | | 13 | | 34 | | 79 | | 220 | | 322 |

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*Formed precipitate when plated.

## Table 52

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 14-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | TA1535 |  | TA1537 |  | TA1538 |  | TA98 |  | TA100 |  |
| Negative control |  |  |  |  |  |  |  |  |  |  |  |  |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
|  | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls |  |  |  |  |  |  |  |  |  |  |  |  |
| Sodium azide | - | 1.0 | 345 | 378 |  |  |  |  |  |  | 387 | 403 |
| 9-Aminoacridine | - | 50.0 |  |  | 467 | 307 |  |  |  |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  |  |  | 903 | 944 | 622 | 649 |  |  |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 14-4 | - | 10 |  | 24 |  | 15 |  | 12 |  | 36 |  | 157 |
|  | - | 50 |  | 13 |  | 15 |  | 15 |  | 37 |  | 166 |
|  | - | 100 |  | 9 |  | 13 |  | 5 |  | 30 |  | 168 |
|  | - | 500* |  | 12 |  | 18 |  | 16 |  | 42 |  | 184 |
|  | - | 1000* |  | 18 |  | 13 |  | 15 |  | 69 |  | 168 |
|  | - | 2500* |  | 17 |  | 26 |  | 25 |  | 66 |  | 189 |
|  | + | 10 |  | 8 |  | 12 |  | 20 |  | 46 |  | 171 |
|  | + | 50 |  | 12 |  | 21 |  | 26 |  | 30 |  | 138 |
|  | + | 100 |  | 10 |  | 23 |  | 24 |  | 37 |  | 172 |
|  | + | 500* |  | 9 |  | 20 |  | 31 |  | 64 |  | 225 |
|  | + | 1000* |  | 13 |  | 22 |  | 51 |  | 80 |  | 256 |
|  | + | 2500* |  | 12 |  | 22 |  | 52 |  | 106 |  | 278 |

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*Formed precipitate when plated.

## Table 53

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 14-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 26 | 16 | 11 | 16 | 14 | 9 | 45 | 40 | 104 | 137 |
| | + | 50000 | 19 | 17 | 15 | 14 | 21 | 16 | 30 | 33 | 130 | 134 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 324 | 373 | | | | | | | 672 | 642 |
| 9-Aminoacridine | - | 50.0 | | | 588 | 703 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 883 | 669 | 456 | 440 | | |
| 2-Anthramine | + | 2.5 | 178 | 167 | 68 | 72 | 316 | 334 | 709 | 701 | 691 | 714 |
| RO 14-4 | - | 50 | | 27 | | 9 | | 9 | | 43 | | 108 |
| | - | 100* | | 26 | | 10 | | 12 | | 43 | | 118 |
| | - | 500* | | 27 | | 13 | | 21 | | 38 | | 151 |
| | - | 1000* | | 23 | | 16 | | 22 | | 61 | | 162 |
| | - | 1500* | | 22 | | 18 | | 22 | | 62 | | 148 |
| | - | 2500* | | 31 | | 18 | | 16 | | 66 | | 127 |
| | + | 50 | | 10 | | 20 | | 27 | | 38 | | 145 |
| | + | 100* | | 9 | | 33 | | 28 | | 50 | | 126 |
| | + | 500* | | 18 | | 29 | | 36 | | 61 | | 236 |
| | + | 1000* | | 12 | | 24 | | 44 | | 70 | | 280 |
| | + | 1500* | | 13 | | 37 | | 48 | | 92 | | 290 |
| | + | 2500* | | 10 | | 26 | | 71 | | 107 | | 315 |

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*Formed precipitate when plated.

Table 54

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 14-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | TA1535 |  | TA1537 |  | TA1538 |  | TA98 |  | TA100 |  |
| Negative control |  |  |  |  |  |  |  |  |  |  |  |  |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
|  | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls |  |  |  |  |  |  |  |  |  |  |  |  |
| Sodium azide | - | 1.0 | 345 | 378 |  |  |  |  |  |  | 387 | 403 |
| 9-Aminoacridine | - | 50.0 |  |  | 467 | 307 |  |  |  |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  |  |  | 903 | 944 | 622 | 649 |  |  |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 14-5 | - | 10 |  | 16 |  | 12 |  | 27 |  | 25 |  | 126 |
|  | - | 50* |  | 20 |  | 9 |  | 13 |  | 38 |  | 142 |
|  | - | 100* |  | 20 |  | 18 |  | 28 |  | 31 |  | 146 |
|  | - | 500* |  | 19 |  | 12 |  | 20 |  | 40 |  | 131 |
|  | - | 1000* |  | 19 |  | 20 |  | 22 |  | 43 |  | 146 |
|  | - | 2500* |  | 22 |  | 16 |  | 15 |  | 38 |  | 159 |
|  | + | 10 |  | 5 |  | 17 |  | 13 |  | 24 |  | 139 |
|  | + | 50* |  | 11 |  | 19 |  | 28 |  | 42 |  | 155 |
|  | + | 100* |  | 13 |  | 19 |  | 28 |  | 53 |  | 188 |
|  | + | 500* |  | 8 |  | 30 |  | 31 |  | 65 |  | 295 |
|  | + | 1000* |  | 5 |  | 18 |  | 40 |  | 77 |  | 245 |
|  | + | 2500* |  | 12 |  | 22 |  | 48 |  | 88 |  | 229 |

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*Formed precipitate when plated.

## Table 55

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 14-5

| Compound | Metabolic Activation | Amount of Compound Added per Plate | Histidine Revertants per Plate |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | TA1535 |  | TA1537 |  | TA1538 |  | TA98 |  | TA100 |  |
| Negative control |  |  |  |  |  |  |  |  |  |  |  |  |
| Dioxane | - | 50000 µg | 26 | 16 | 11 | 16 | 14 | 9 | 45 | 40 | 104 | 137 |
|  | + | 50000 | 19 | 17 | 15 | 14 | 21 | 16 | 30 | 33 | 130 | 134 |
| Positive controls |  |  |  |  |  |  |  |  |  |  |  |  |
| Sodium azide | - | 1.0 | 324 | 373 |  |  |  |  |  |  | 672 | 642 |
| 9-Aminoacridine | - | 50.0 |  |  | 588 | 703 |  |  |  |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  |  |  | 883 | 669 | 456 | 440 |  |  |
| 2-Anthramine | + | 2.5 | 178 | 167 | 68 | 72 | 316 | 334 | 709 | 701 | 691 | 714 |
| RO 14-5 | + | 2 µl |  |  |  |  |  |  |  | 54 |  | 214 |
|  | + | 5 |  |  |  |  |  |  |  | 38 |  | 190 |
|  | + | 10 |  |  |  |  |  |  |  | 72 |  | 237 |
|  | + | 20 |  |  |  |  |  |  |  | NT* |  | 298 |

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*NT, not tested.

## Table 56

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 14-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 14-6 | - | 10 | | 15 | | 11 | | 13 | | 28 | | 140 |
| | - | 50 | | 9 | | 12 | | 11 | | 38 | | 142 |
| | - | 100* | | 21 | | 10 | | 17 | | 44 | | 148 |
| | - | 500* | | 15 | | 14 | | 15 | | 43 | | 156 |
| | - | 1000* | | 26 | | 16 | | 10 | | 33 | | 149 |
| | - | 2500* | | 22 | | 8 | | 11 | | 21 | | 121 |
| | + | 10 | | 10 | | 30 | | 12 | | 27 | | 145 |
| | + | 50 | | 8 | | 20 | | 24 | | 30 | | 150 |
| | + | 100* | | 11 | | 13 | | 19 | | 35 | | 145 |
| | + | 500* | | 10 | | 20 | | 28 | | 56 | | 233 |
| | + | 1000* | | 16 | | 14 | | 36 | | 74 | | 242 |
| | + | 2500* | | 14 | | 16 | | 33 | | 78 | | 248 |

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*Formed precipitate when plated.

## Table 57

## *IN VITRO* ASSAYS WITH *SALMONELLA TYPHIMURIUM*

RO 14-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 26 | 16 | 11 | 16 | 14 | 9 | 45 | 40 | 104 | 137 |
| | + | 50000 | 19 | 17 | 15 | 14 | 21 | 16 | 30 | 33 | 130 | 134 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 324 | 373 | | | | | | | 672 | 642 |
| 9-Aminoacridine | - | 50.0 | | | 588 | 703 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 883 | 669 | 456 | 440 | | |
| 2-Anthramine | + | 2.5 | 178 | 167 | 68 | 72 | 316 | 334 | 709 | 701 | 691 | 714 |
| RO 14-6 | - | 10 | | 22 | | 5 | | 13 | | 16 | | 85 |
| | - | 50* | | 20 | | 18 | | 10 | | 21 | | 108 |
| | - | 100* | | 15 | | 10 | | 8 | | 20 | | 91 |
| | - | 500* | | 22 | | 14 | | 9 | | 39 | | 92 |
| | - | 1000* | | 23 | | 10 | | 10 | | 37 | | 121 |
| | - | 2500* | | NT† | | NT | | 41 | | 25 | | 117 |
| | + | 10 | | 7 | | 12 | | 13 | | 31 | | 114 |
| | + | 50* | | 14 | | 17 | | 14 | | 47 | | 115 |
| | + | 100* | | 14 | | 5 | | 12 | | 52 | | 170 |
| | + | 500* | | 9 | | 16 | | 25 | | 54 | | 183 |
| | + | 1000* | | 6 | | 22 | | 36 | | 66 | | 192 |
| | + | 2500* | | NT | | 15 | | 42 | | 55 | | 181 |

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[*] Formed precipitated when plated.

[†] NT, not tested.

## Table 58

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 14-7

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 14-7 | - | 1 | | 6 | | 14 | | 16 | | 43 | | 111 |
| | - | 5 | | 15 | | 7 | | 21 | | 42 | | 149 |
| | - | 10 | | 14 | | 20 | | 13 | | 54 | | 119 |
| | - | 50* | | 19 | | 21 | | 16 | | 49 | | 128 |
| | - | 100* | | 28 | | 13 | | 17 | | 42 | | 144 |
| | - | 500* | | 20 | | 24 | | 12 | | 37 | | 111 |
| | + | 1 | | 7 | | 16 | | 20 | | 38 | | 147 |
| | + | 5 | | 11 | | 22 | | 23 | | 42 | | 171 |
| | + | 10 | | 10 | | 21 | | 21 | | 38 | | 153 |
| | + | 50* | | 15 | | 22 | | 18 | | 51 | | 168 |
| | + | 100* | | 19 | | 19 | | 27 | | 38 | | 187 |
| | + | 500* | | 9 | | 22 | | 39 | | 55 | | 254 |

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*Formed precipitate when plated.

## Table 59

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 15-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 15-1 | - | 10 | | 20 | | 7 | | 9 | | 38 | | 137 |
| | - | 50 | | 20 | | 11 | | 16 | | 33 | | 135 |
| | - | 100 | | 21 | | 16 | | 13 | | 30 | | 125 |
| | - | 500 | | 15 | | 17 | | 18 | | 34 | | 111 |
| | - | 1000 | | 13 | | 16 | | 17 | | 24 | | 108 |
| | - | 2500 | | 15 | | 7 | | 6 | | 21 | | 110 |
| | + | 10 | | 9 | | 19 | | 12 | | 37 | | 162 |
| | + | 50 | | 6 | | 19 | | 13 | | 26 | | 167 |
| | + | 100 | | 16 | | 20 | | 14 | | 30 | | 159 |
| | + | 500 | | 13 | | 14 | | 21 | | 41 | | 160 |
| | + | 1000 | | 9 | | 12 | | 16 | | 45 | | 177 |
| | + | 2500 | | 9 | | 14 | | 29 | | 42 | | 170 |

Table 60

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 15-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 32 | 42 | 17 | 16 | 6 | 5 | 40 | 36 | 143 | 149 |
| | + | 50000 | 30 | 17 | 28 | 32 | 36 | 18 | 44 | 39 | 176 | 158 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 520 | 491 | | | | | | | 671 | 596 |
| 9-Aminoacridine | - | 50.0 | | | 91 | 113 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 340 | 406 | 280 | 261 | | |
| 2-Anthramine | + | 2.5 | 184 | 208 | 86 | 97 | 545 | 624 | 572 | 463 | 1085 | 1117 |
| RO 15-1 | - | 50 | | 36 | | 15 | | 24 | | 31 | | 136 |
| | - | 100 | | 31 | | 16 | | 20 | | 42 | | 147 |
| | - | 500 | | 24 | | 14 | | 14 | | 37 | | 138 |
| | - | 1000 | | 42 | | 16 | | 18 | | 37 | | 146 |
| | - | 1500 | | 27 | | 8 | | 14 | | 40 | | 143 |
| | - | 2500 | | 26 | | 5 | | 20 | | 37 | | 154 |
| | + | 50 | | C* | | 18 | | 24 | | 42 | | 172 |
| | + | 100 | | 16 | | 33 | | 21 | | 30 | | 126 |
| | + | 500 | | 9 | | 36 | | 26 | | 50 | | 134 |
| | + | 1000 | | 19 | | 27 | | 20 | | 49 | | 174 |
| | + | 1500 | | 16 | | 39 | | 24 | | 42 | | 183 |
| | + | 2500 | | 19 | | 30 | | 27 | | 52 | | 155 |

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*C, contaminated.

Table 61

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 15-2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | TA1535 |  | TA1537 |  | TA1538 |  | TA98 |  | TA100 |  |
| Negative control |  |  |  |  |  |  |  |  |  |  |  |  |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
|  | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls |  |  |  |  |  |  |  |  |  |  | 387 | 403 |
| Sodium azide | - | 1.0 | 345 | 378 |  |  |  |  |  |  |  |  |
| 9-Aminoacridine | - | 50.0 |  |  | 467 | 307 |  |  |  |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  |  |  | 903 | 944 | 622 | 649 |  |  |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 15-2 | - | 10 |  | 9 |  | 10 |  | 14 |  | 21 |  | 136 |
|  | - | 50 |  | 15 |  | 11 |  | 8 |  | 18 |  | 135 |
|  | - | 100 |  | 15 |  | 12 |  | 12 |  | 32 |  | 102 |
|  | - | 500 |  | 14 |  | 13 |  | 11 |  | 28 |  | 123 |
|  | - | 1000 |  | 20 |  | 16 |  | 14 |  | 35 |  | 111 |
|  | - | 2500 |  | 22 |  | 15 |  | 19 |  | 36 |  | 93 |
|  | + | 10 |  | 18 |  | 19 |  | 26 |  | 32 |  | 140 |
|  | + | 50 |  | 6 |  | 19 |  | 25 |  | 43 |  | 166 |
|  | + | 100 |  | 17 |  | 27 |  | 27 |  | 39 |  | 185 |
|  | + | 500 |  | 6 |  | 23 |  | 45 |  | 69 |  | 263 |
|  | + | 1000 |  | 17 |  | 19 |  | 61 |  | 95 |  | 270 |
|  | + | 2500 |  | 9 |  | 25 |  | 71 |  | 112 |  | 226 |

## Table 62

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 15-2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | TA1535 |  | TA1537 |  | TA1538 |  | TA98 |  | TA100 |  |
| Negative control |  |  |  |  |  |  |  |  |  |  |  |  |
| Dioxane | - | 50000 | 32 | 42 | 17 | 16 | 6 | 5 | 40 | 36 | 143 | 149 |
|  | + | 50000 | 30 | 17 | 28 | 32 | 36 | 18 | 44 | 39 | 176 | 158 |
| Positive controls |  |  |  |  |  |  |  |  |  |  |  |  |
| Sodium azide | - | 1.0 | 520 | 491 |  |  |  |  |  |  | 671 | 596 |
| 9-Aminoacridine | - | 50.0 |  |  | 91 | 113 |  |  |  |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  |  |  | 340 | 406 | 280 | 261 |  |  |
| 2-Anthramine | + | 2.5 | 184 | 208 | 86 | 97 | 545 | 624 | 572 | 463 | 1085 | 1117 |
| RO 15-2 | - | 10 |  | 17 |  | 8 |  | 17 |  | 33 |  | 143 |
|  | - | 50 |  | 21 |  | 16 |  | 9 |  | 41 |  | 125 |
|  | - | 100 |  | 25 |  | 12 |  | 13 |  | 25 |  | 128 |
|  | - | 500 |  | 38 |  | 14 |  | 8 |  | 32 |  | 125 |
|  | - | 1000 |  | 31 |  | 25 |  | 19 |  | 39 |  | 101 |
|  | - | 1500 |  | 25 |  | 19 |  | 13 |  | 49 |  | 128 |
|  | + | 10 |  | 5 |  | 32 |  | 37 |  | 62 |  | 195 |
|  | + | 50 |  | 6 |  | 32 |  | 37 |  | 68 |  | 174 |
|  | + | 100 |  | 17 |  | 40 |  | 32 |  | 68 |  | 185 |
|  | + | 500 |  | 5 |  | 43 |  | 65 |  | 91 |  | 259 |
|  | + | 1000 |  | 12 |  | 49 |  | 75 |  | 110 |  | 274 |
|  | + | 1500 |  | 14 |  | 51 |  | 79 |  | 105 |  | 289 |

Table 63

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 15-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 15-3 | - | 10 | | 25 | | 17 | | 23 | | 35 | | 155 |
| | - | 50 | | 12 | | 27 | | 18 | | 53 | | 149 |
| | - | 100* | | 16 | | 21 | | 17 | | 72 | | 200 |
| | - | 500* | | 14 | | 48 | | 34 | | 146 | | 241 |
| | - | 1000* | | 13 | | 54 | | 61 | | 236 | | 289 |
| | - | 2500* | | 15 | | 79 | | 78 | | 296 | | 284 |
| | + | 10 | | 10 | | 14 | | 19 | | 49 | | 181 |
| | + | 50 | | 13 | | 16 | | 32 | | 78 | | 264 |
| | + | 100* | | 10 | | 19 | | 42 | | 92 | | 372 |
| | + | 500* | | 12 | | 46 | | 67 | | 151 | | 431 |
| | + | 1000* | | 12 | | 59 | | 68 | | 200 | | 441 |
| | + | 2500* | | 7 | | 65 | | 82 | | 258 | | 389 |

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*Formed precipitate when plated.

## Table 64

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 15-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 32 | 42 | 17 | 16 | 6 | 5 | 40 | 36 | 143 | 149 |
| | + | 50000 | 30 | 17 | 28 | 32 | 36 | 18 | 44 | 39 | 176 | 158 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 520 | 491 | | | | | | | 671 | 596 |
| 9-Aminoacridine | - | 50.0 | | | 91 | 113 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 340 | 406 | 280 | 261 | | |
| 2-Anthramine | + | 2.5 | 184 | 208 | 86 | 97 | 545 | 624 | 572 | 463 | 1085 | 1117 |
| RO 15-3 | - | 10 | | 24 | | 11 | | 11 | | 32 | | 156 |
| | - | 50 | | 25 | | 9 | | 19 | | 35 | | 199 |
| | - | 100* | | 33 | | 19 | | 24 | | 45 | | 200 |
| | - | 500* | | 22 | | 42 | | 47 | | 82 | | 208 |
| | - | 1000* | | 18 | | 50 | | 85 | | 203 | | 238 |
| | - | 2500* | | 29 | | 32 | | 41 | | 166 | | 191 |
| | + | 10 | | 10 | | 18 | | 14 | | 52 | | 218 |
| | + | 50 | | 12 | | 26 | | 29 | | 43 | | 223 |
| | + | 100* | | 11 | | 28 | | 32 | | 93 | | 293 |
| | + | 500* | | 13 | | 37 | | 53 | | 128 | | 334 |
| | + | 1000* | | 14 | | 38 | | 85 | | 127 | | 304 |
| | + | 2500* | | P† | | 31 | | 74 | | 114 | | 293 |

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*Formed precipitate when plated.

†P, pinpoint.

## Table 65

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 15-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate<br>TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| Ro 15-4 | - | 10 | | 10 | | 5 | | 10 | | 39 | | 116 |
| | - | 50 | | 17 | | 13 | | 11 | | 34 | | 113 |
| | - | 100* | | 16 | | 6 | | 13 | | 34 | | 113 |
| | - | 500* | | 15 | | 5 | | 14 | | 35 | | 107 |
| | - | 1000* | | 11 | | 12 | | 7 | | 39 | | 138 |
| | - | 2500* | | 19 | | 15 | | 20 | | 23 | | 140 |
| | + | 10 | | 16 | | 10 | | 25 | | 36 | | 143 |
| | + | 50 | | 8 | | 13 | | 17 | | 28 | | 129 |
| | + | 100* | | 8 | | 16 | | 28 | | 30 | | 133 |
| | + | 500* | | 12 | | 19 | | 26 | | 44 | | 185 |
| | + | 1000* | | 17 | | 18 | | 41 | | 78 | | 215 |
| | + | 2500* | | 10 | | 21 | | 45 | | 66 | | 291 |

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*Formed precipitate when plated.

Table 66

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 15-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| **Negative control** | | | | | | | | | | | | |
| Dioxane | - | 50000 | 32 | 42 | 17 | 16 | 6 | 5 | 40 | 36 | 143 | 149 |
| | + | 50000 | 30 | 17 | 28 | 32 | 36 | 18 | 44 | 39 | 176 | 158 |
| **Positive controls** | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 520 | 491 | | | | | | | 671 | 596 |
| 9-Aminoacridine | - | 50.0 | | | 91 | 113 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 340 | 406 | 280 | 261 | | |
| 2-Anthramine | + | 2.5 | 184 | 208 | 86 | 97 | 545 | 624 | 572 | 463 | 1085 | 1117 |
| RO 15-4 | - | 50 | | 28 | | 12 | | 8 | | 37 | | 160 |
| | - | 100 | | 31 | | 12 | | 11 | | 33 | | 147 |
| | - | 500* | | 32 | | 15 | | 18 | | 28 | | 146 |
| | - | 1000* | | 27 | | 12 | | 18 | | 38 | | 140 |
| | - | 1500* | | 29 | | 16 | | 15 | | 28 | | 161 |
| | - | 2500* | | 28 | | 12 | | 14 | | 26 | | 139 |
| | + | 50 | | 22 | | 27 | | 21 | | 40 | | 148 |
| | + | 100 | | 15 | | 26 | | 20 | | 28 | | 175 |
| | + | 500* | | 20 | | 33 | | 24 | | 49 | | 247 |
| | + | 1000* | | 25 | | C† | | 25 | | 60 | | 253 |
| | + | 1500* | | 16 | | 35 | | 35 | | 56 | | 259 |
| | + | 2500* | | 14 | | 27 | | 35 | | 71 | | 250 |

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*Formed precipitate when plated.

†C, contaminated.

## Table 67

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

### RO 15-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | TA1535 |  | TA1537 |  | TA1538 |  | TA98 |  | TA100 |  |
| Negative control |  |  |  |  |  |  |  |  |  |  |  |  |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
|  | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls |  |  |  |  |  |  |  |  |  |  |  |  |
| Sodium azide | - | 1.0 | 345 | 378 |  |  |  |  |  |  | 387 | 403 |
| 9-Aminoacridine | - | 50.0 |  |  | 467 | 307 |  |  |  |  |  |  |
| 2-Nitrofluorene | - | 5.0 |  |  |  |  | 903 | 944 | 622 | 649 |  |  |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 15-5 | - | 10 |  | 11 |  | 8 |  | 17 |  | 27 |  | 120 |
|  | - | 50 |  | 14 |  | 15 |  | 18 |  | 33 |  | 144 |
|  | - | 100* |  | 12 |  | 10 |  | 23 |  | 31 |  | 139 |
|  | - | 500* |  | 13 |  | 14 |  | 13 |  | 40 |  | 142 |
|  | - | 1000* |  | 17 |  | 13 |  | 11 |  | 33 |  | 153 |
|  | - | 2500* |  | 25 |  | 16 |  | 19 |  | 28 |  | 149 |
|  | + | 10 |  | 11 |  | 12 |  | 14 |  | 38 |  | 139 |
|  | + | 50 |  | 9 |  | 15 |  | 23 |  | 50 |  | 150 |
|  | + | 100* |  | 10 |  | 15 |  | 30 |  | 50 |  | 226 |
|  | + | 500* |  | 7 |  | 16 |  | 39 |  | 70 |  | 284 |
|  | + | 1000* |  | 7 |  | 26 |  | 55 |  | 89 |  | 344 |
|  | + | 2500* |  | 15 |  | 24 |  | 56 |  | 76 |  | 281 |

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*Formed precipitate when plated.

Table 68

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 15-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 32 | 42 | 17 | 16 | 6 | 5 | 40 | 36 | 143 | 149 |
| | + | 50000 | 30 | 17 | 28 | 32 | 36 | 18 | 44 | 39 | 176 | 158 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 520 | 491 | | | | | | | 671 | 596 |
| 9-Aminoacridine | - | 50.0 | | | 91 | 113 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 340 | 406 | 280 | 261 | | |
| 2-Anthramine | + | 2.5 | 184 | 208 | 86 | 97 | 545 | 624 | 572 | 463 | 1085 | 1117 |
| RO 15-5 | - | 10 | | 31 | | 11 | | 9 | | 28 | | 219 |
| | - | 50 | | 42 | | 11 | | 11 | | 30 | | 162 |
| | - | 100* | | 32 | | 14 | | 12 | | 76 | | 165 |
| | - | 500* | | 30 | | 13 | | 19 | | 31 | | 147 |
| | - | 1000* | | 27 | | 13 | | 14 | | 38 | | 160 |
| | - | 1500* | | 27 | | 11 | | 22 | | 33 | | 186 |
| | + | 10 | | 12 | | 22 | | 20 | | 46 | | 148 |
| | + | 50 | | 24 | | 29 | | 22 | | 40 | | 184 |
| | + | 100* | | 13 | | 28 | | 26 | | 48 | | 205 |
| | + | 500* | | 14 | | 25 | | 35 | | 52 | | 229 |
| | + | 1000* | | 18 | | 21 | | 52 | | 67 | | 254 |
| | + | 1500* | | 13 | | 25 | | 39 | | 65 | | 260 |

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*Formed precipitate when plated.

Table 69

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 15-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 15-6 | - | 10 | | 14 | | 7 | | 14 | | 32 | | 125 |
| | - | 50 | | 21 | | 10 | | 13 | | 39 | | 125 |
| | - | 100* | | 21 | | 17 | | 16 | | 34 | | 131 |
| | - | 500* | | 17 | | 15 | | 26 | | 39 | | 132 |
| | - | 1000* | | 24 | | 13 | | 13 | | 32 | | 142 |
| | - | 2500* | | 19 | | 14 | | 19 | | 23 | | 126 |
| | + | 10 | | 14 | | 20 | | 25 | | 36 | | 177 |
| | + | 50 | | 17 | | 21 | | 13 | | 26 | | 157 |
| | + | 100* | | 11 | | 19 | | 14 | | 30 | | 134 |
| | + | 500* | | 9 | | 24 | | 12 | | 47 | | 183 |
| | + | 1000* | | 6 | | 17 | | 32 | | 70 | | 204 |
| | + | 2500* | | 9 | | 26 | | 40 | | 63 | | 190 |

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*Formed precipitate when plated.

Table 70

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 15-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 32 | 42 | 17 | 16 | 6 | 5 | 40 | 36 | 143 | 149 |
| | + | 50000 | 30 | 17 | 28 | 32 | 36 | 18 | 44 | 39 | 176 | 158 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 520 | 491 | | | | | | | 671 | 596 |
| 9-Aminoacridine | - | 50.0 | | | 91 | 113 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 340 | 406 | 280 | 261 | | |
| 2-Anthramine | + | 2.5 | 184 | 208 | 86 | 97 | 545 | 624 | 572 | 463 | 1085 | 1117 |
| RO 15-6 | - | 50* | | 31 | | 10 | | 9 | | 33 | | 198 |
| | - | 100* | | 23 | | 15 | | 18 | | 42 | | 170 |
| | - | 250* | | 32 | | 11 | | 7 | | 36 | | 171 |
| | - | 500* | | 20 | | 11 | | 13 | | 38 | | 165 |
| | - | 1000* | | 28 | | 15 | | 12 | | 33 | | 155 |
| | - | 1500* | | 28 | | 11 | | 12 | | 36 | | 184 |
| | + | 50* | | 16 | | 18 | | 15 | | 27 | | 167 |
| | + | 100* | | 16 | | 15 | | 26 | | 41 | | 170 |
| | + | 250* | | 22 | | 18 | | 24 | | 43 | | 185 |
| | + | 500* | | 19 | | 22 | | 24 | | 51 | | 190 |
| | + | 1000* | | 9 | | 27 | | 21 | | 66 | | 217 |
| | + | 1500* | | 26 | | 38 | | 30 | | 67 | | 231 |

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*Formed precipitate when plated.

## Table 71

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 15-7

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 15-7 | - | 1 | | 22 | | 6 | | 14 | | 25 | | 132 |
| | - | 5 | | 10 | | 12 | | 8 | | 22 | | 133 |
| | - | 10 | | 13 | | 12 | | 11 | | 48 | | 150 |
| | - | 50 | | 13 | | 15 | | 15 | | 37 | | 159 |
| | - | 100* | | 20 | | 16 | | 9 | | 44 | | 151 |
| | - | 500* | | 13 | | 15 | | 15 | | 20 | | 147 |
| | + | 1 | | 8 | | 24 | | 21 | | 37 | | 157 |
| | + | 5 | | 8 | | 21 | | 21 | | 31 | | 147 |
| | + | 10 | | 13 | | 20 | | 15 | | 34 | | 169 |
| | + | 50 | | 16 | | 26 | | 21 | | 41 | | 178 |
| | + | 100* | | 13 | | 21 | | 21 | | 43 | | 154 |
| | + | 500* | | NT[†] | | NT | | 20 | | NT | | 154 |

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[*] Formed precipitate when plated.

[†] NT, not tested.

## Table 72

### IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 16-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 16-1 | - | 10 | | 20 | | 8 | | 17 | | 15 | | 116 |
| | - | 50 | | 14 | | 15 | | 12 | | 25 | | 117 |
| | - | 100 | | 17 | | 8 | | 8 | | 16 | | 125 |
| | - | 500 | | 19 | | 11 | | 15 | | 18 | | 114 |
| | - | 1000 | | 15 | | 11 | | 19 | | 32 | | 122 |
| | - | 2500 | | 17 | | 14 | | 15 | | 20 | | 116 |
| | + | 10 | | 13 | | 16 | | 28 | | 45 | | 135 |
| | + | 50 | | 14 | | 7 | | 17 | | 40 | | 143 |
| | + | 100 | | 14 | | 13 | | 7 | | 32 | | 126 |
| | + | 500 | | 9 | | 12 | | 9 | | 33 | | 146 |
| | + | 1000 | | 7 | | 12 | | 30 | | 39 | | 152 |
| | + | 2500 | | 6 | | 12 | | 28 | | 33 | | 141 |

## Table 73

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 16-1

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 30 | 30 | 6 | 13 | 13 | 17 | 32 | 30 | 128 | 124 |
| | + | 50000 | 17 | 20 | 12 | 26 | 28 | 20 | 57 | 43 | 117 | 110 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 450 | 536 | | | | | | | 541 | 466 |
| 9-Aminoacridine | - | 50.0 | | | 186 | 219 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 746 | 907 | 467 | 458 | | |
| 2-Anthramine | + | 2.5 | 519 | 446 | 197 | 196 | 462 | 550 | 1972 | 2100 | 2319 | 2142 |
| RO 16-1 | - | 10 | | 19 | | 9 | | 15 | | 37 | | 111 |
| | - | 50 | | 20 | | 9 | | 17 | | 52 | | 128 |
| | - | 100 | | 34 | | 9 | | 14 | | 30 | | 115 |
| | - | 500 | | 29 | | 14 | | 18 | | 36 | | 136 |
| | - | 1000 | | 25 | | 14 | | 13 | | 44 | | 108 |
| | - | 2500 | | 26 | | 8 | | 18 | | 41 | | 128 |
| | + | 10 | | 15 | | 30 | | 39 | | 64 | | 128 |
| | + | 50 | | 17 | | 31 | | 28 | | 56 | | 103 |
| | + | 100 | | 13 | | 36 | | 30 | | 55 | | 126 |
| | + | 500 | | 15 | | 27 | | 30 | | 67 | | 127 |
| | + | 1000 | | 15 | | 29 | | 30 | | 55 | | 140 |
| | + | 2500 | | 7 | | 28 | | 27 | | 57 | | 150 |

Table 74

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 16-2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 16-2 | - | 10 | | 15 | | 6 | | 7 | | 18 | | 105 |
| | - | 50 | | 21 | | 6 | | 8 | | 9 | | 93 |
| | - | 100 | | 15 | | 5 | | 11 | | 12 | | 99 |
| | - | 500 | | 16 | | 14 | | 16 | | 15 | | 100 |
| | - | 1000 | | 15 | | 7 | | P* | | 8 | | 75 |
| | - | 2500 | | 21 | | 6 | | P | | 26 | | 86 |
| | + | 10 | | 5 | | 19 | | 38 | | 31 | | 104 |
| | + | 50 | | 12 | | 8 | | 37 | | 41 | | 126 |
| | + | 100 | | 9 | | 13 | | 39 | | 45 | | 131 |
| | + | 500 | | 6 | | 30 | | 63 | | 69 | | 146 |
| | + | 1000 | | 8 | | 28 | | 39 | | 80 | | 165 |
| | + | 2500 | | 6 | | 33 | | 39 | | 51 | | 99 |

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*P, pinoint.

## Table 75

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 16-2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 30 | 30 | 6 | 13 | 13 | 17 | 32 | 30 | 128 | 124 |
| | + | 50000 | 17 | 20 | 12 | 26 | 28 | 20 | 57 | 43 | 117 | 110 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 450 | 536 | | | | | | | 541 | 466 |
| 9-Aminoacridine | - | 50.0 | | | 186 | 219 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 746 | 907 | 467 | 458 | | |
| 2-Anthramine | + | 2.5 | 519 | 446 | 197 | 196 | 462 | 550 | 1972 | 2100 | 2319 | 2142 |
| RO 16-2 | - | 10 | | 24 | | 24 | | 26 | | 42 | | 113 |
| | - | 50 | | 27 | | 13 | | 39 | | 31 | | 116 |
| | - | 100 | | 26 | | 12 | | 43 | | 24 | | 89 |
| | - | 500 | | 24 | | 17 | | 51 | | 30 | | 102 |
| | - | 1000 | | 24 | | 20 | | 61 | | 49 | | 92 |
| | - | 2500 | | 31 | | 9 | | 53 | | 45 | | 90 |
| | + | 10 | | 7 | | 17 | | 30 | | 52 | | 126 |
| | + | 50 | | 8 | | 27 | | 36 | | 80 | | 150 |
| | + | 100 | | 7 | | 26 | | 40 | | 85 | | 173 |
| | + | 500 | | 13 | | 33 | | 48 | | 113 | | 258 |
| | + | 1000 | | 18 | | 25 | | 51 | | 111 | | 263 |
| | + | 2500 | | 17 | | 29 | | 53 | | 87 | | 251 |

Table 76

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 16-2

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1538 | | | TA98 | | | TA100 | | |
| Negative control | | | | | | | | | | | |
| Dioxane | + | 50,000 | 31 | 33 | 61 | 68 | 50 | 56 | 161 | 126 | 174 |
| Positive controls | | | | | | | | | | | |
| Sodium azide | - | 1.0 | | | | | | | | 446 | 435 |
| 2-Nitrofluorene | - | 5.0 | | 539 | 498 | | 356 | 661 | | | |
| 2-Anthramine | + | 2.5 | | 677 | 631 | | 482 | 497 | | 890 | 1211 |
| RO 16-2 | + | 10 | | 19 | 14 | | | | | 188 | 226 |
| | + | 50 | | 32 | 21 | | | | | 194 | 250 |
| | + | 100 | | 27 | 38 | | | | | 218 | 262 |
| | + | 500 | | 49 | 55 | | | | | 245 | 332 |
| | + | 1000 | | 61 | 63 | | | | | 312 | 295 |
| | + | 2500 | | 92 | 86 | | | | | 220 | 320 |

## Table 77

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 16-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 16-3 | - | 10 | | 14 | | 14 | | 15 | | 37 | | 143 |
| | - | 50 | | 26 | | 9 | | 24 | | 46 | | 155 |
| | - | 100* | | 18 | | 15 | | 16 | | 53 | | 181 |
| | - | 500* | | 13 | | 21 | | 33 | | 122 | | 221 |
| | - | 1000* | | 18 | | 38 | | 65 | | 222 | | 227 |
| | - | 2500* | | 11 | | 58 | | 58 | | 237 | | 188 |
| | + | 10 | | 10 | | 25 | | 31 | | 41 | | 206 |
| | + | 50 | | 14 | | 25 | | 47 | | 76 | | 356 |
| | + | 100* | | 12 | | 34 | | 49 | | 110 | | 441 |
| | + | 500* | | 11 | | 24 | | 48 | | 102 | | 428 |
| | + | 1000* | | 7 | | 47 | | 74 | | 129 | | 440 |
| | + | 2500* | | 9 | | 53 | | 88 | | 166 | | 623 |

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*Formed precipitate when plated.

Table 78

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 16-3

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 30 | 30 | 6 | 13 | 13 | 17 | 32 | 30 | 128 | 124 |
| | + | 50000 | 17 | 20 | 12 | 26 | 28 | 20 | 57 | 43 | 117 | 110 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 450 | 536 | | | | | | | 541 | 466 |
| 9-Aminoacridine | - | 50.0 | | | 186 | 219 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 746 | 907 | 467 | 458 | | |
| 2-Anthramine | + | 2.5 | 519 | 446 | 197 | 196 | 462 | 550 | 1972 | 2100 | 2319 | 2142 |
| RO 16-3 | - | 10 | | 30 | | 15 | | 16 | | 41 | | 125 |
| | - | 50* | | 33 | | 26 | | 21 | | 45 | | 115 |
| | - | 100* | | 41 | | 16 | | 17 | | 61 | | 125 |
| | - | 500* | | 24 | | 50 | | 27 | | 91 | | 141 |
| | - | 1000* | | 22 | | 32 | | 40 | | 97 | | 147 |
| | - | 2500* | | 21 | | 25 | | 36 | | 101 | | 140 |
| | + | 10 | | 13 | | 17 | | 30 | | 68 | | 155 |
| | + | 50* | | 20 | | 26 | | 41 | | 104 | | 284 |
| | + | 100* | | 12 | | 47 | | 72 | | 105 | | 370 |
| | + | 500* | | 17 | | 54 | | 83 | | 182 | | 482 |
| | + | 1000* | | 14 | | 72 | | 91 | | 203 | | 478 |
| | + | 2500* | | 16 | | 35 | | 93 | | 201 | | 521 |

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*Formed precipitate when plated.

Table 79

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 16-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 16-4 | - | 10 | | 14 | | 15 | | 14 | | 24 | | 122 |
| | - | 50* | | 16 | | 12 | | 13 | | 31 | | 151 |
| | - | 100* | | 19 | | 19 | | 13 | | 39 | | 148 |
| | - | 500* | | 20 | | 26 | | 23 | | 57 | | 192 |
| | - | 1000* | | 10 | | 34 | | 16 | | 68 | | 226 |
| | - | 2500* | | 18 | | 32 | | 29 | | 117 | | 281 |
| | + | 10 | | 13 | | 12 | | 24 | | 30 | | 169 |
| | + | 50* | | 10 | | 15 | | 18 | | 47 | | 188 |
| | + | 100* | | 16 | | 25 | | 23 | | 54 | | 194 |
| | + | 500* | | 17 | | 35 | | 37 | | 95 | | 291 |
| | + | 1000* | | 14 | | 49 | | 54 | | 108 | | 375 |
| | + | 2500* | | 12 | | 56 | | 101 | | 136 | | 437 |

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*Formed precipitate when plated.

### Table 80

### IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 16-4

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 30 | 30 | 6 | 13 | 13 | 17 | 32 | 30 | 128 | 124 |
| | + | 50000 | 17 | 20 | 12 | 26 | 28 | 20 | 57 | 43 | 117 | 110 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 450 | 536 | | | | | | | 541 | 466 |
| 9-Aminoacridine | - | 50.0 | | | 186 | 219 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 746 | 907 | 467 | 458 | | |
| 2-Anthramine | + | 2.5 | 519 | 446 | 197 | 196 | 462 | 550 | 1972 | 2100 | 2319 | 2142 |
| RO 16-4 | - | 10 | | 27 | | 15 | | 12 | | 34 | | 127 |
| | - | 50* | | 28 | | 14 | | 23 | | 42 | | 149 |
| | - | 100* | | 30 | | 17 | | 19 | | 29 | | 141 |
| | - | 500* | | 31 | | 16 | | 18 | | 46 | | 168 |
| | - | 1000* | | 31 | | 21 | | 22 | | 73 | | 175 |
| | - | 2500* | | 28 | | 23 | | 34 | | 91 | | 218 |
| | + | 10 | | 13 | | 31 | | 38 | | 67 | | 147 |
| | + | 50* | | 14 | | 23 | | 38 | | 55 | | 167 |
| | + | 100* | | 13 | | 33 | | 30 | | 64 | | 153 |
| | + | 500* | | 18 | | 40 | | 49 | | 103 | | 315 |
| | + | 1000* | | 17 | | 41 | | 44 | | 124 | | 394 |
| | + | 2500* | | 19 | | 35 | | 68 | | 101 | | 309 |

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*Formed precipitate when plated.

## Table 81

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 16-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 16-5 | - | 10 | | 11 | | 6 | | 14 | | 44 | | 130 |
| | - | 50 | | 17 | | 18 | | 20 | | 35 | | 124 |
| | - | 100 | | 19 | | 19 | | 16 | | 34 | | 156 |
| | - | 500* | | 18 | | 20 | | 14 | | 59 | | 164 |
| | - | 1000* | | 14 | | 26 | | 22 | | 70 | | 205 |
| | - | 2500* | | 15 | | 24 | | 14 | | 77 | | 163 |
| | + | 10 | | 10 | | 16 | | 24 | | 38 | | 131 |
| | + | 50 | | 14 | | 21 | | 29 | | 58 | | 207 |
| | + | 100 | | 13 | | 23 | | 45 | | 65 | | 239 |
| | + | 500* | | 14 | | 29 | | 37 | | 80 | | 285 |
| | + | 1000* | | 11 | | 20 | | 55 | | 72 | | 292 |
| | + | 2500* | | 14 | | 33 | | 54 | | 74 | | 275 |

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*Formed precipitate when plated.

## Table 82

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 16-5

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 30 | 30 | 6 | 13 | 13 | 17 | 32 | 30 | 128 | 124 |
| | + | 50000 | 17 | 20 | 12 | 26 | 28 | 20 | 57 | 43 | 117 | 110 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 450 | 536 | | | | | | | 541 | 466 |
| 9-Aminoacridine | - | 50.0 | | | 186 | 219 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 746 | 907 | 467 | 458 | | |
| 2-Anthramine | + | 2.5 | 519 | 446 | 197 | 196 | 462 | 550 | 1972 | 2100 | 2319 | 2142 |
| RO 16-5 | - | 10 | | 40 | | 16 | | 16 | | 54 | | 129 |
| | - | 50 | | 16 | | 15 | | 24 | | 44 | | 147 |
| | - | 100 | | 41 | | 17 | | 17 | | 43 | | 152 |
| | - | 500* | | 40 | | 26 | | 20 | | 50 | | 162 |
| | - | 1000* | | 36 | | 25 | | 36 | | 51 | | 171 |
| | - | 2500* | | NT* | | NT | | NT | | 53 | | 186 |
| | + | 10 | | 12 | | 19 | | 19 | | 51 | | 153 |
| | + | 50 | | 11 | | 39 | | 31 | | 64 | | 187 |
| | + | 100 | | 19 | | 29 | | 32 | | 75 | | 260 |
| | + | 500* | | 14 | | 40 | | 64 | | 105 | | 268 |
| | + | 1000* | | 15 | | 40 | | 64 | | 107 | | 265 |
| | + | 2500* | | NT | | 28 | | 64 | | 96 | | 181 |

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*Formed precipitate when plated.

Table 83

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 16-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 16-6 | - | 10 | | 21 | | C[*] | | 13 | | 34 | | 146 |
| | - | 50 | | 17 | | 14 | | 17 | | 28 | | 143 |
| | - | 100[†] | | 20 | | 23 | | 12 | | 42 | | 176 |
| | - | 500[†] | | 16 | | 30 | | 20 | | 42 | | 157 |
| | - | 1000[†] | | C | | 15 | | 20 | | 34 | | 170 |
| | - | 2500[†] | | 16 | | 15 | | 10 | | 30 | | 144 |
| | + | 10 | | 18 | | 14 | | 22 | | 31 | | 167 |
| | + | 50 | | 19 | | 11 | | 24 | | 39 | | 173 |
| | + | 100[†] | | 7 | | 14 | | 25 | | 46 | | 192 |
| | + | 500[†] | | 14 | | 19 | | 38 | | 71 | | 335 |
| | + | 1000[†] | | 8 | | 19 | | 50 | | 97 | | 396 |
| | + | 2500[†] | | 12 | | 18 | | 56 | | 115 | | 390 |

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[*] C, contaminated.

[†] Formed precipitate when plated.

## Table 84

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 16-6

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 30 | 30 | 6 | 13 | 13 | 17 | 32 | 30 | 128 | 124 |
| | + | 50000 | 17 | 20 | 12 | 26 | 28 | 20 | 57 | 43 | 117 | 110 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 450 | 536 | | | | | | | 541 | 466 |
| 9-Aminoacridine | - | 50.0 | | | 186 | 219 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 746 | 907 | 467 | 458 | | |
| 2-Anthramine | + | 2.5 | 519 | 446 | 197 | 196 | 462 | 550 | 1972 | 2100 | 2319 | 2142 |
| RO 16-6 | - | 10 | | 23 | | 12 | | 13 | | 43 | | 121 |
| | - | 50* | | 23 | | 14 | | 14 | | 29 | | 114 |
| | - | 100* | | 24 | | 6 | | 17 | | 44 | | 152 |
| | - | 500* | | 31 | | 13 | | 14 | | 38 | | 154 |
| | - | 1000* | | 34 | | 12 | | 23 | | 34 | | 167 |
| | - | 2500* | | 28 | | 13 | | 22 | | 49 | | 111 |
| | + | 10 | | 8 | | 26 | | 39 | | 65 | | 138 |
| | + | 50* | | 11 | | 26 | | 23 | | 66 | | 166 |
| | + | 100* | | 17 | | 30 | | 39 | | 68 | | 174 |
| | + | 500* | | 1[illegible] | | 31 | | 53 | | 79 | | 265 |
| | + | 1000* | | 13 | | 37 | | 61 | | 97 | | 261 |
| | + | 2500* | | 18 | | 30 | | 83 | | 114 | | 211 |

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*Formed precipitate when plated.

Table 85

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM
RO 16-7

| Compound | Metabolic Activation | Micrograms of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 | 18 | 17 | 12 | 14 | 14 | 13 | 29 | 28 | 131 | 143 |
| | + | 50000 | 15 | 9 | 26 | 21 | 28 | 27 | 31 | 30 | 134 | 141 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 345 | 378 | | | | | | | 387 | 403 |
| 9-Aminoacridine | - | 50.0 | | | 467 | 307 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 903 | 944 | 622 | 649 | | |
| 2-Anthramine | + | 2.5 | 259 | 253 | 212 | 277 | 288 | 262 | 331 | 281 | 596 | 593 |
| RO 16-7 | - | 1 | | 13 | | 16 | | 17 | | 23 | | 159 |
| | - | 5 | | 16 | | 18 | | 13 | | 37 | | 155 |
| | - | 10 | | 13 | | 16 | | 13 | | 29 | | 167 |
| | - | 50* | | 17 | | 12 | | 21 | | 29 | | 158 |
| | - | 100* | | 18 | | 23 | | 13 | | C† | | 150 |
| | - | 500* | | 22 | | 12 | | 15 | | 23 | | 159 |
| | + | 1 | | 11 | | 24 | | 23 | | 36 | | 169 |
| | + | 5 | | 7 | | 18 | | 21 | | 28 | | 172 |
| | + | 10 | | 11 | | 17 | | 13 | | 39 | | 176 |
| | + | 50* | | 11 | | 20 | | 23 | | 37 | | 166 |
| | + | 100* | | 5 | | 19 | | 23 | | 69 | | 180 |
| | + | 500* | | 11 | | 16 | | 34 | | 53 | | 216 |

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*Formed precipitate when plated.

†C, contaminated.

## Table 86

## IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

RO 16-7

| Compound | Metabolic Activation | Amount of Compound Added per Plate | Histidine Revertants per Plate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TA1535 | | TA1537 | | TA1538 | | TA98 | | TA100 | |
| Negative control | | | | | | | | | | | | |
| Dioxane | - | 50000 µg | 30 | 30 | 6 | 13 | 13 | 17 | 32 | 30 | 128 | 124 |
| | + | 50000 | 17 | 20 | 12 | 26 | 28 | 20 | 57 | 43 | 117 | 110 |
| Positive controls | | | | | | | | | | | | |
| Sodium azide | - | 1.0 | 450 | 536 | | | | | | | 541 | 466 |
| 9-Aminoacridine | - | 50.0 | | | 186 | 219 | | | | | | |
| 2-Nitrofluorene | - | 5.0 | | | | | 746 | 907 | 467 | 458 | | |
| 2-Anthramine | + | 2.5 | 519 | 446 | 197 | 196 | 462 | 550 | 1972 | 2100 | 2319 | 2142 |
| RO 16-7 | + | 10 µl* | | | | | | | | | | 118 |
| | + | 20 µl* | | | | | | | | | | 162 |
| | + | 30 µl* | | | | | | | | | | 217 |
| | + | 50 µl* | | | | | | | | | | 227 |

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*Formed precipitate when plated.

## APPENDIX C

### BIOASSAY DATA OF SEVEN FRACTIONS OF SIX RESIDUAL OILS AS BAR GRAPHS

To facilitate the viewing and interpretation of the large amount of data present in Tables 15, 16, 17, 18, 19, and 20, the results have been displayed in a graph form, with the average of each two tests displaying the combined bioactivity. This is presented as Appendix C.

Curve 719319-A

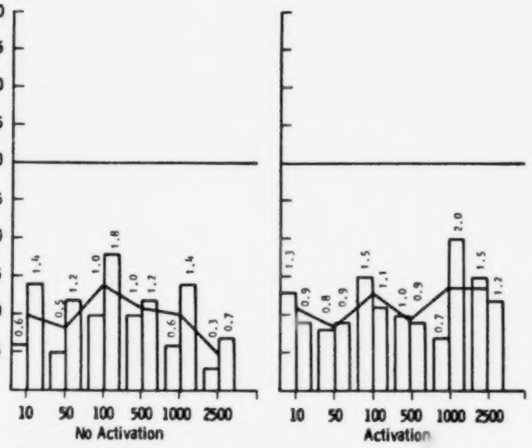


Fig. C1 – SRI AMES test data on residual oil fractions

Sample RO 1-1 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719318-A

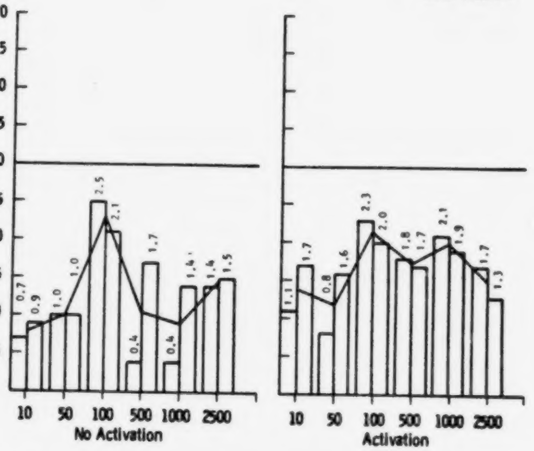
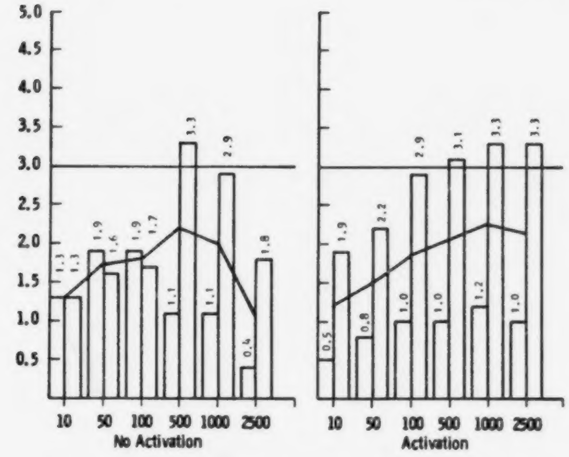


Fig. C2 – SRI AMES test data on residual oil fractions

Sample RO 1-2 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

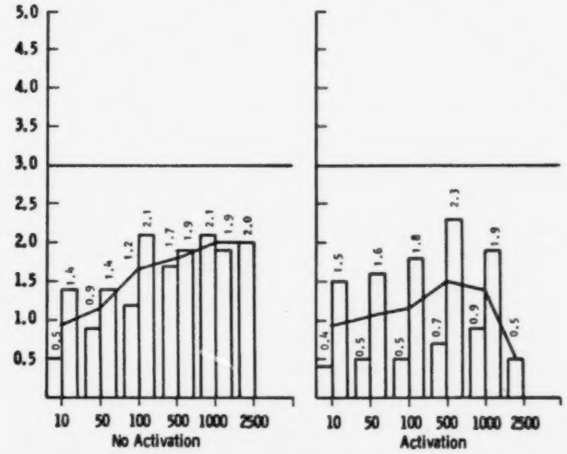


Curve 719317-A

Fig. C3 — SRI AMES test data on residual oil fractions

Sample RO 1-3 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.



Curve 719316-A

Fig. C4 — SRI AMES test data on residual oil fractions

Sample RO 1-4 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

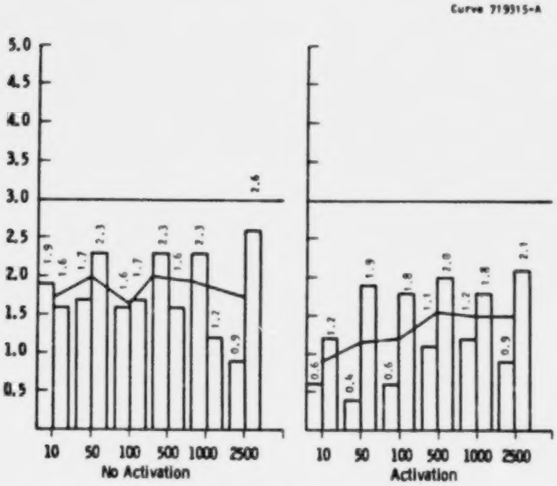


Fig. C5 – SRI AMES test data on residual oil fractions

Sample RO 1-5 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

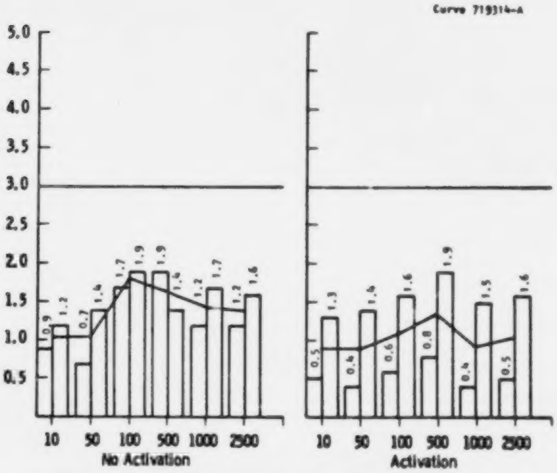


Fig. C6 – SRI AMES test data on residual oil fractions

Sample RO 1-6 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

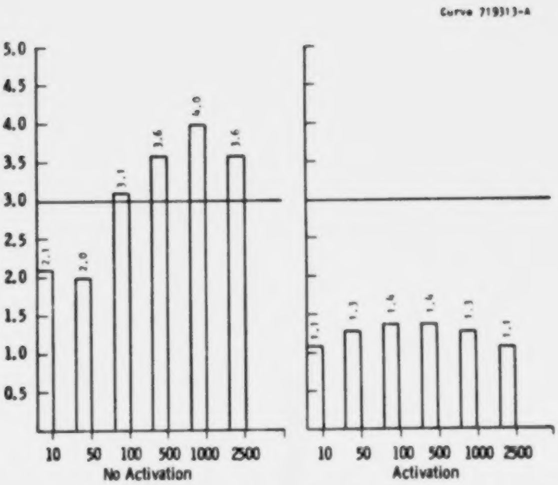


Fig. C7 – SRI AMES test data on residual oil fractions

Sample RO 1-7 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

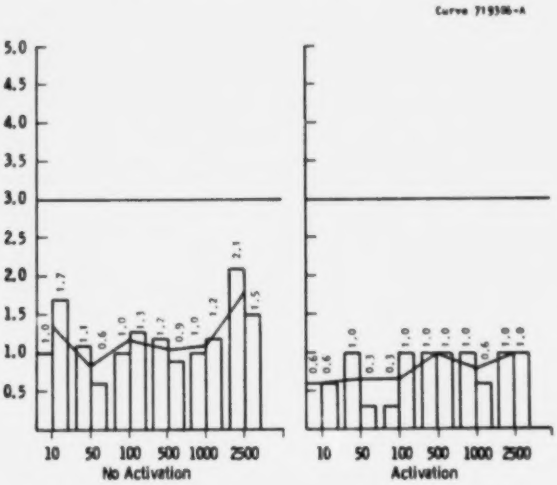


Fig. C8 – SRI AMES test data on residual oil fractions

Sample RO 1-1 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

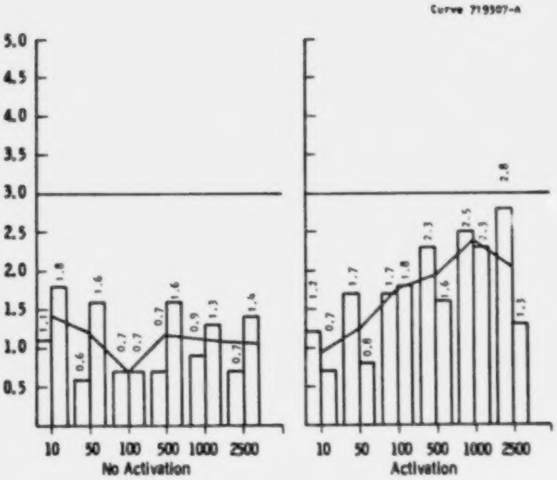


Fig. C9 – SRI AMES test data on residual oil fractions

Sample RO 1-2     Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

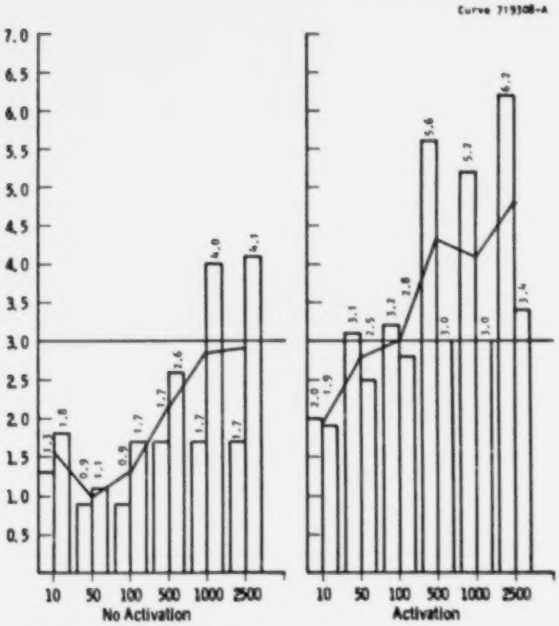


Fig. C10 – SRI AMES test data on residual oil fractions

Smaple RO 1-3     Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

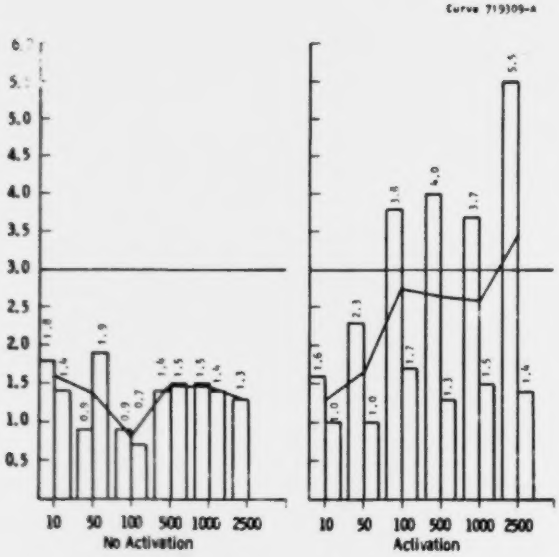


Fig. C11 – SRI AMES test data on residual oil fractions

Sample RO 1-4 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

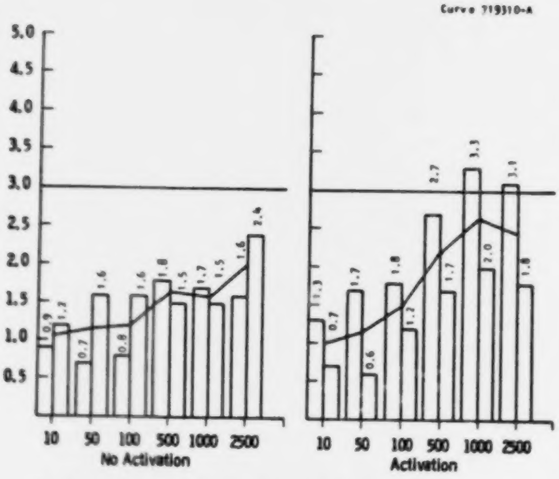


Fig. C12 – SRI AMES test data on residual oil fractions

Sample RO 1-5 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

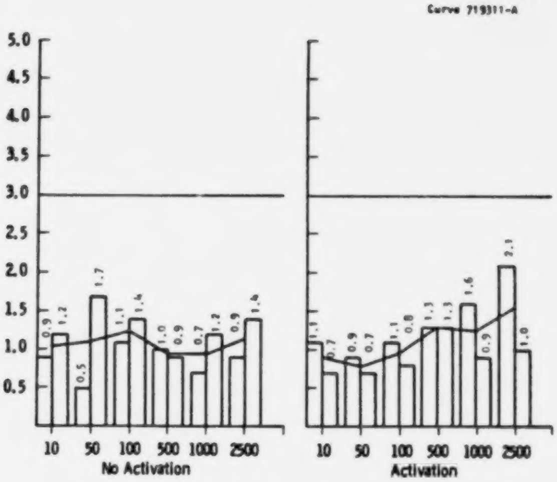


Fig. C13 – SRI AMES test data on residual oil fractions

Sample RO 1-6 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

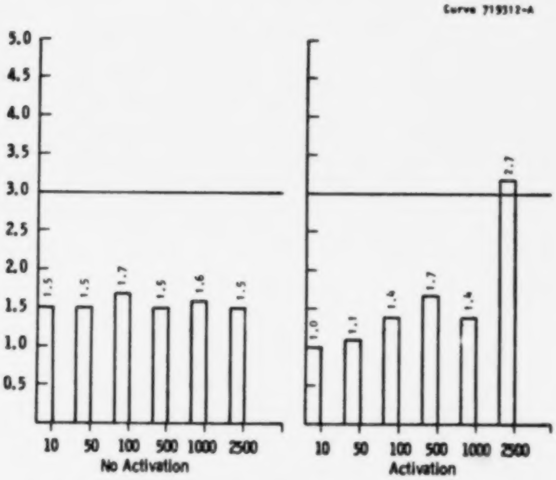


Fig. C14 – SRI AMES test data on residual oil fractions

Sample RO 1-7 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

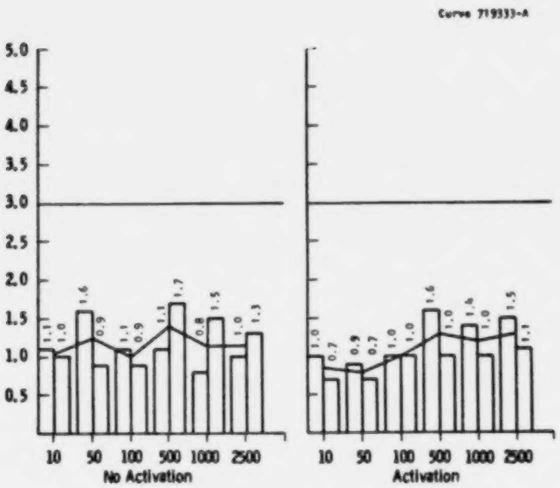


Fig. C15 – SRI AMES test data on residual oil fractions

Sample RO 1-1 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

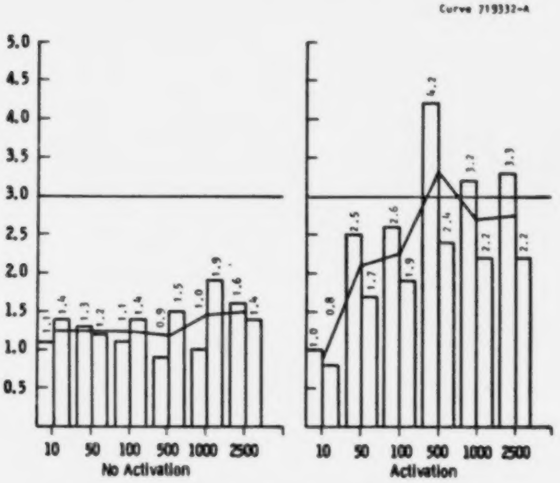


Fig. C16 – SRI AMES test data on residual oil fractions

Sample RO 1-2 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719331-A

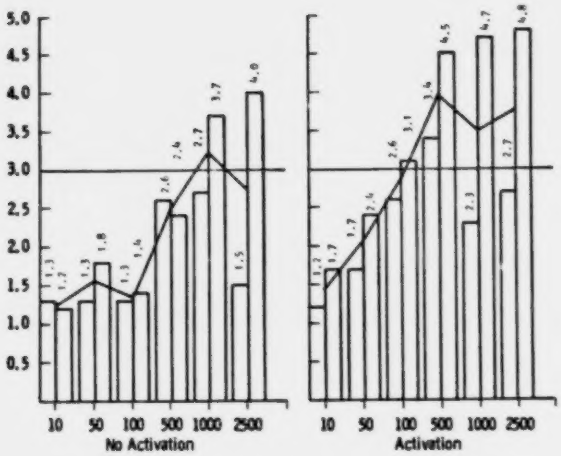


Fig. C17 – SRI AMES test data on residual oil fractions

Sample RO 1-3    Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719330-A

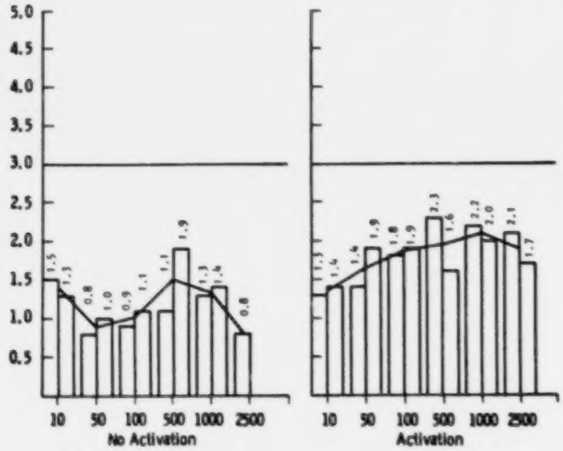


Fig. C18 – SRI AMES test data on residual oil fractions

Sample RO 1-4    Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

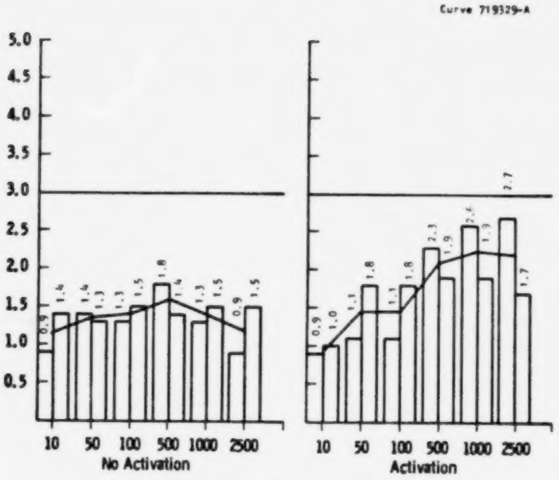


Fig. C19 — SRI AMES test data on residual oil fractions

Sample RO 1-5  Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

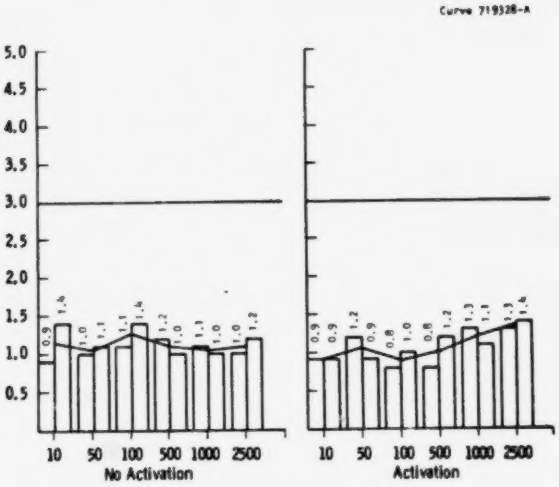


Fig. C20 — SRI AMES test data on residual oil fractions

Sample RO 1-6  Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719327-A

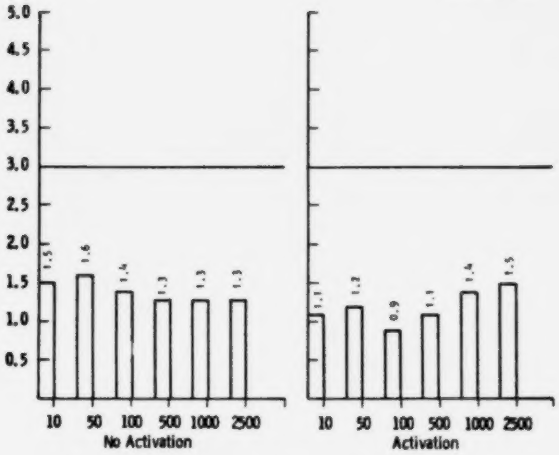


Fig. C21 – SRI AMES test data on residual oil fractions

Sample RO 1-7 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719326-A

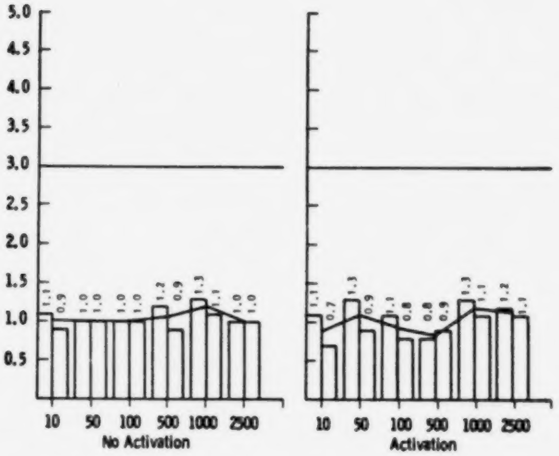


Fig. C22 – SRI AMES test data on residual oil fractions

Sample RO 1-1 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

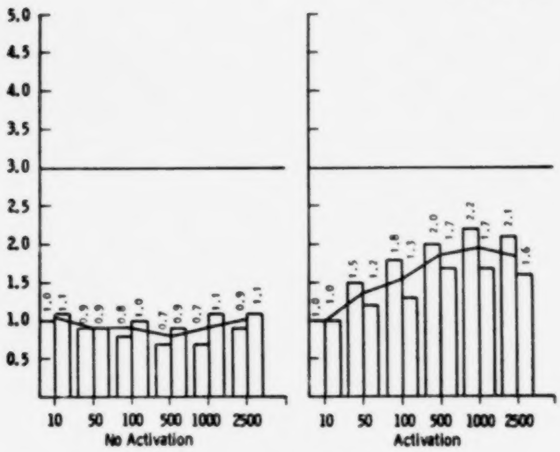


Fig. C23 – SRI AMES test data on residual oil fractions

Sample RO 1-2 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

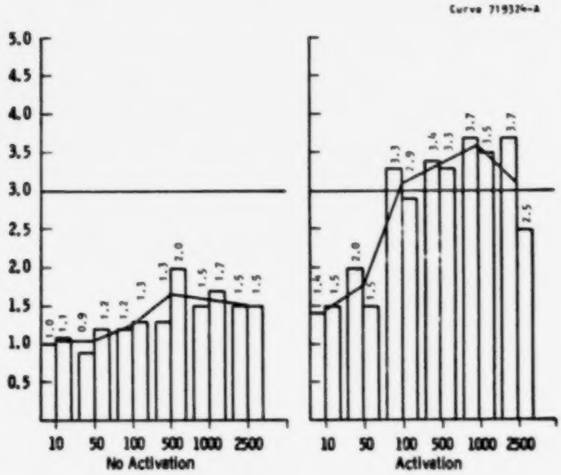


Fig. C24 – SRI AMES test data on residual oil fractions

Sample RO 1-3 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719323-A

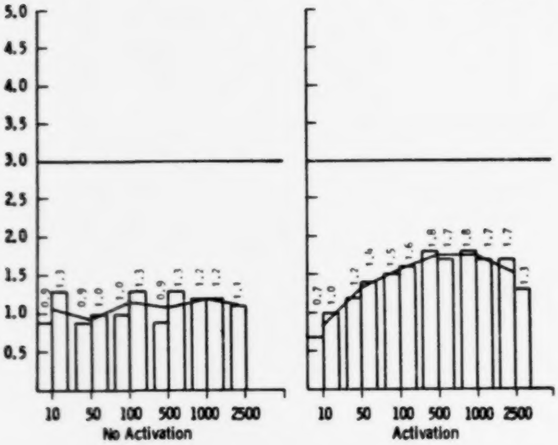


Fig. C25 – SRI AMES test data on residual oil fractions

Sample RO 1-4    Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719322-A

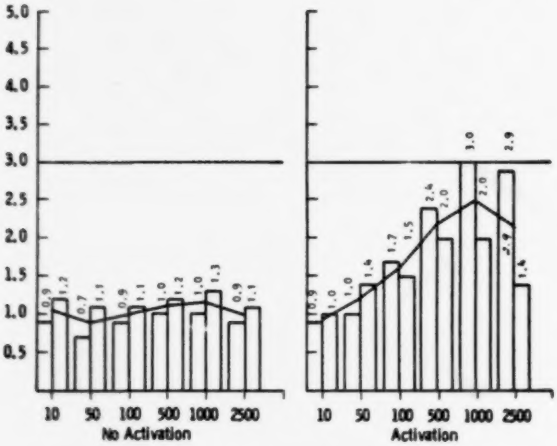


Fig. C26 – SRI AMES test data on residual oil fractions

Sample RO 1-5    Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

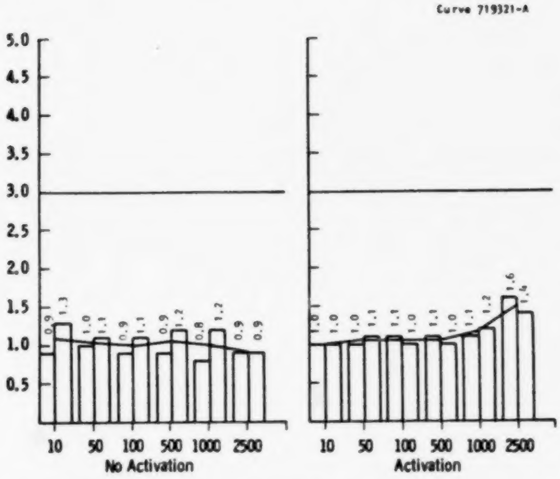


**Fig. C27 – SRI AMES test data on residual oil fractions**

Sample RO 1-6 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

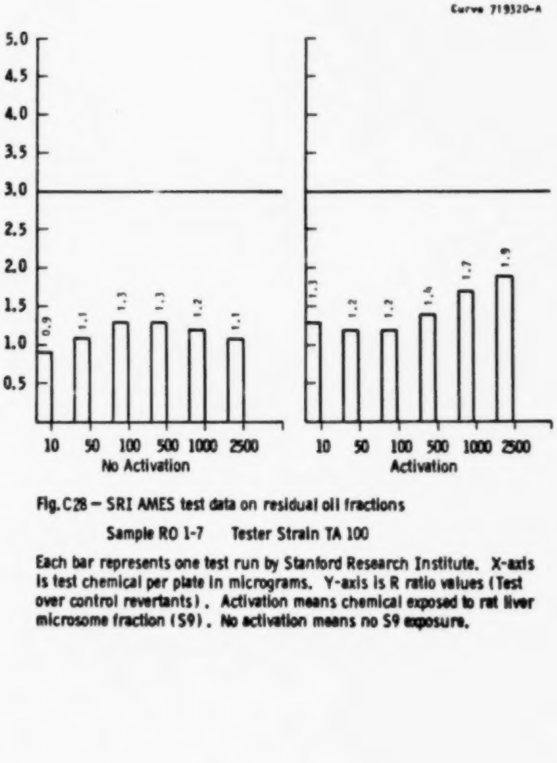


**Fig. C28 – SRI AMES test data on residual oil fractions**

Sample RO 1-7 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

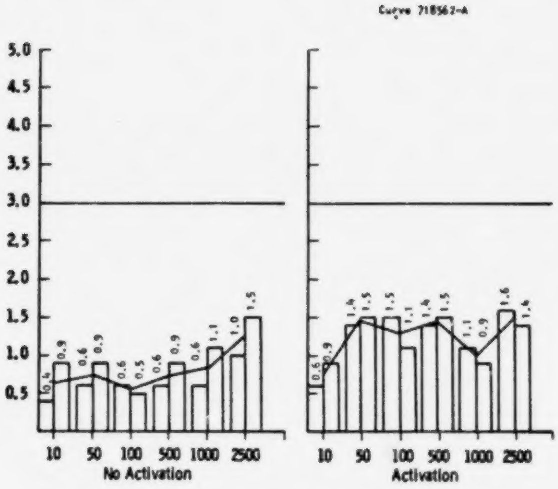


Fig.C29 – SRI AMES test data on residual oil fractions

Sample RO 12-1. Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

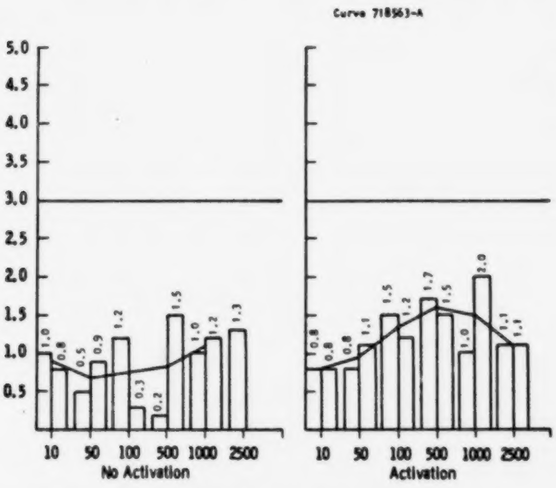


Fig.C30 – SRI AMES test data on residual oil fractions

Sample RO 12-2. Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

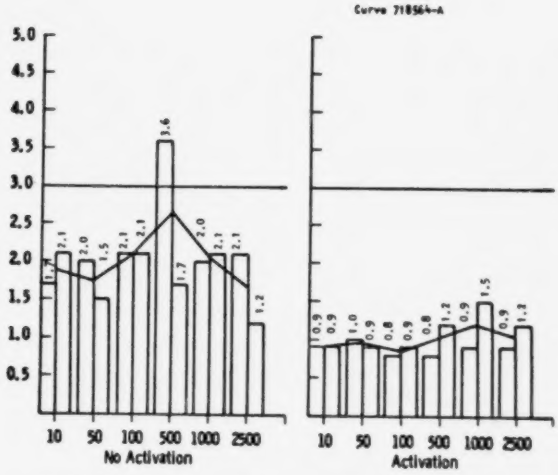


Fig. C31 – SRI AMES test data on residual oil fractions

Sample RO 12-3, Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

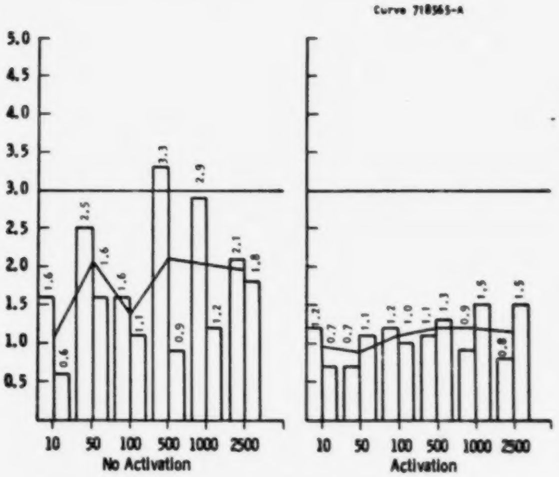


Fig. C32 – SRI AMES test data on residual oil fractions

Sample RO 12-4, Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

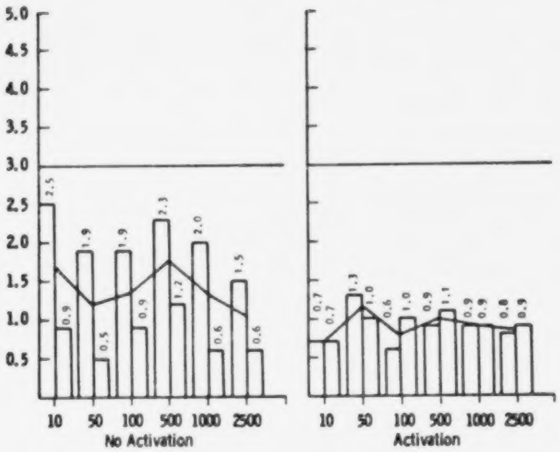


Fig. C33 — SRI AMES test data on residual oil fractions

Sample RO 12-5. Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

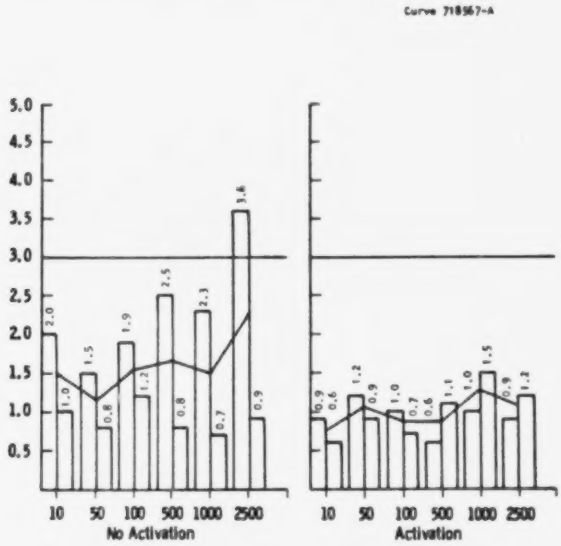


Fig. C34 — SRI AMES test data on residual oil fractions

Sample RO 12-6. Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

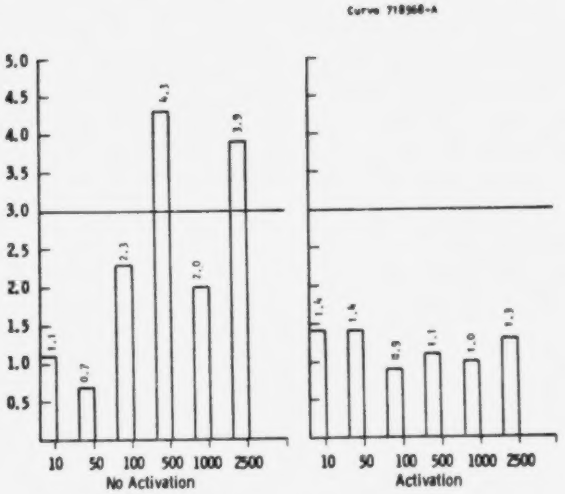


Fig. C35 – SRI AMES test data on residual oil fractions

Sample RO 12-7. Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

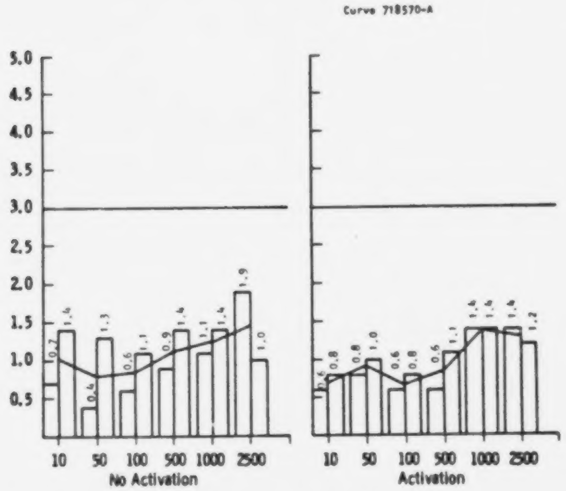


Fig. C36 – SRI AMES test data on residual oil fractions

Sample RO 12-1. Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718569-A

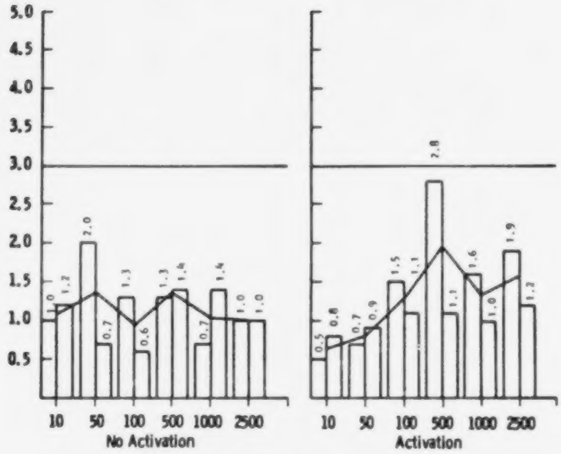


Fig. C37 – SRI AMES test data on residual oil fractions

Sample RO 12-2. Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718571-A

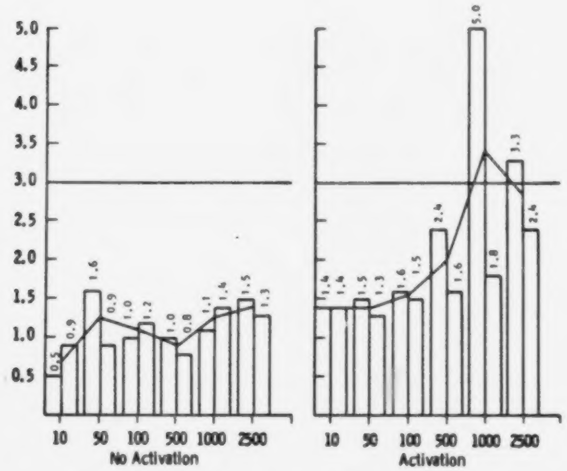


Fig. C38 – SRI AMES test data on residual oil fractions

Sample RO 12-3. Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

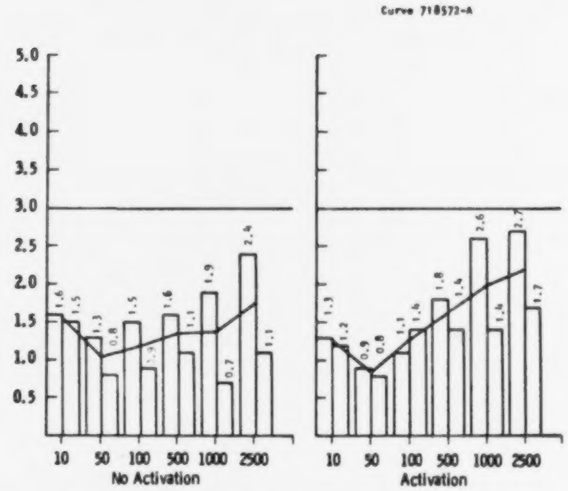


Fig. C39 — SRI AMES test data on residual oil fractions

Sample RO 12-4. Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

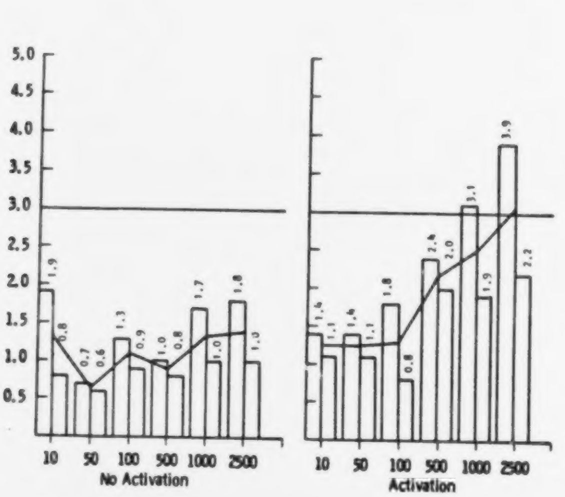


Fig. C40 — SRI AMES test data on residual oil fractions

Sample RO 12-5. Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

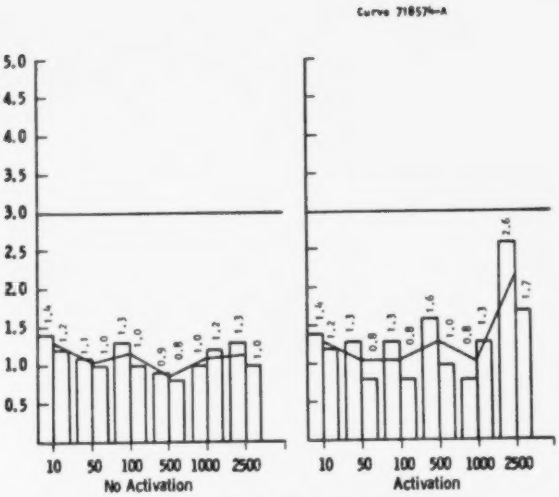


Fig. C41 – SRI AMES test data on residual oil fractions

Sample RO 12-6. Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

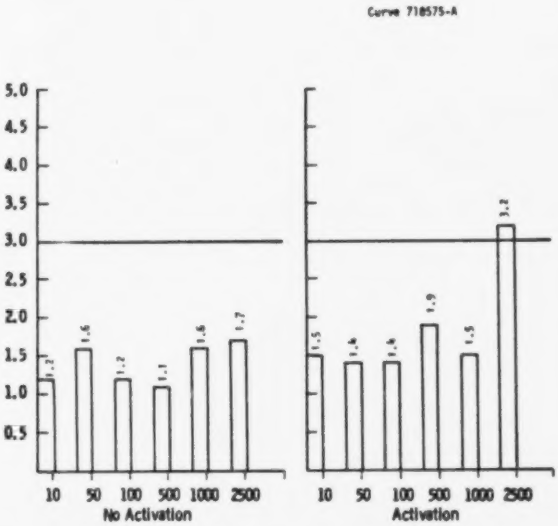


Fig. C42 – SRI AMES test data on residual oil fractions

Sample RO 12-7. Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718555-A

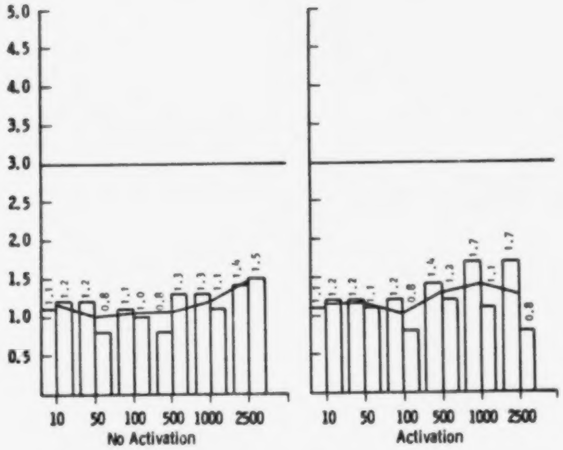


Fig.C43 – SRI AMES test data on residual oil fractions

Sample RO 12-1. Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718556-A

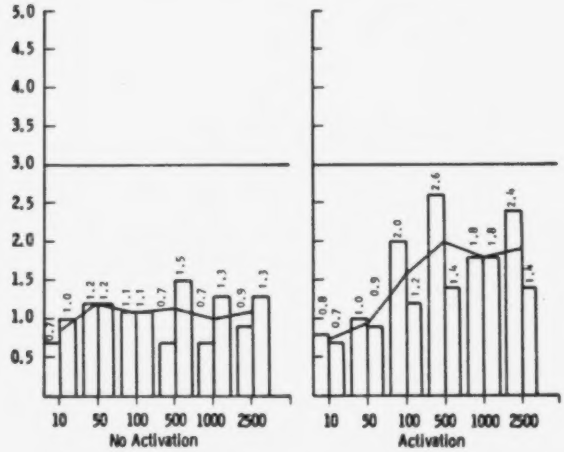


Fig.C44 – SRI AMES test data on residual oil fractions

Sample RO 12-2. Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718557-A

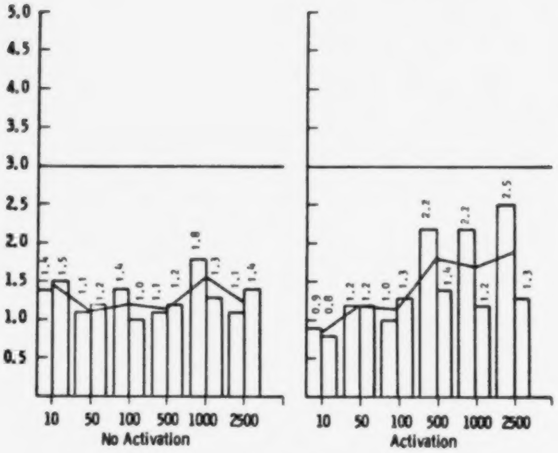


Fig. C45 – SRI AMES test data on residual oil fractions

Sample RO 12-3. Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718558-A

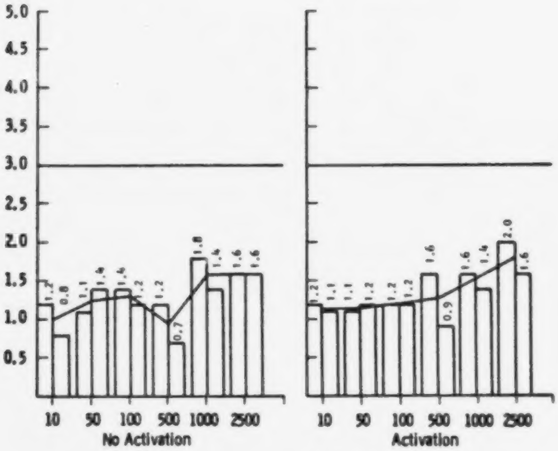


Fig. C46 – SRI AMES test data on residual oil fractions

Sample RO 12-4. Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

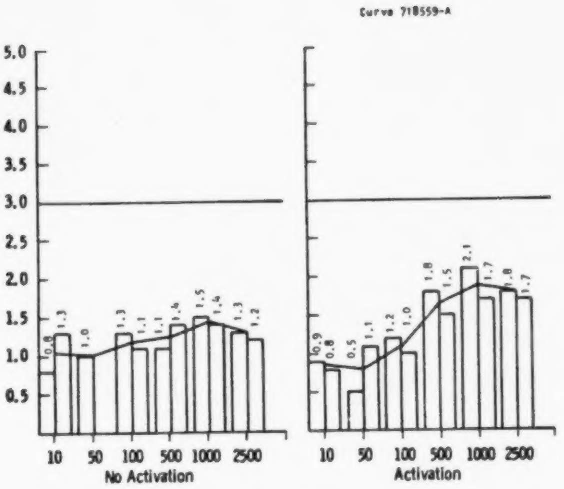


Fig. C47 – SRI AMES test data on residual oil fractions

Sample RO 12-5. Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

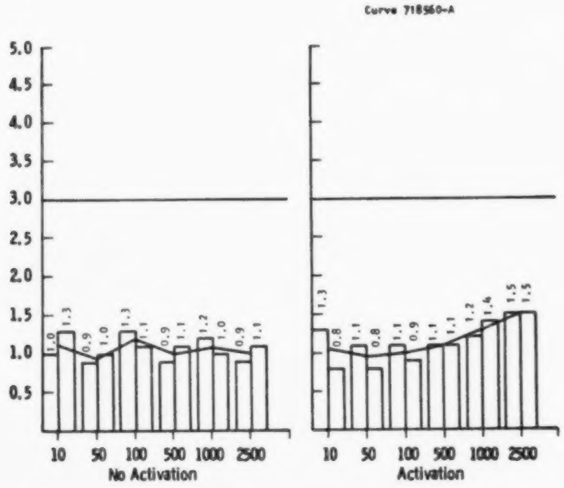


Fig. C48 – SRI AMES test data on residual oil fractions

Sample RO 12-6. Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

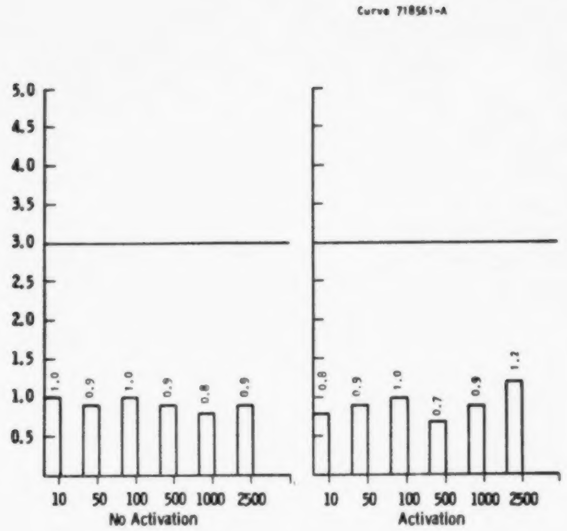


Fig. C49 – SRI AMES test data on residual oil fractions

Sample RO 12-7. Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

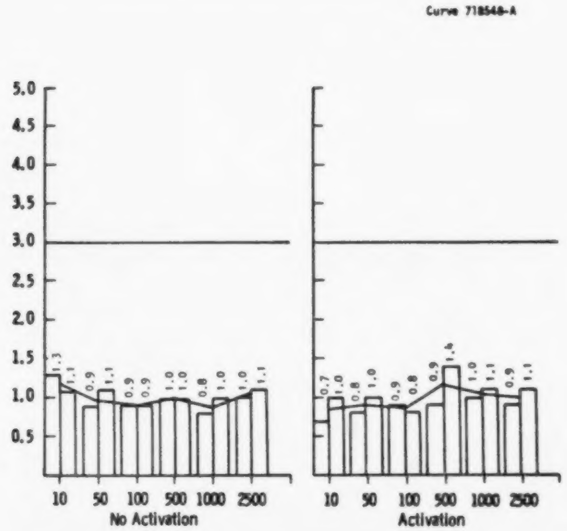


Fig. C50 – SRI AMES test data on residual oil fractions

Sample RO 12-1. Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718549-A

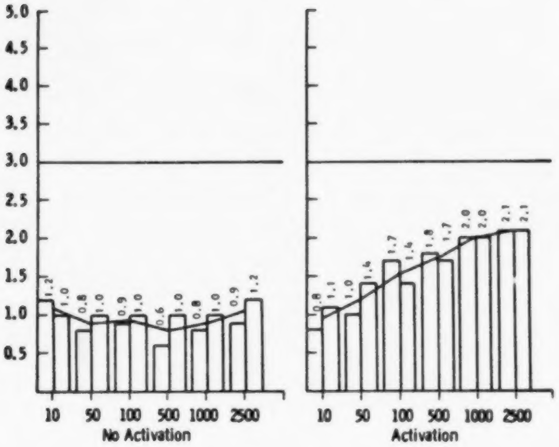


Fig. C51 – SRI AMES test data on residual oil fractions

Sample RO 12-2. Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718550-A

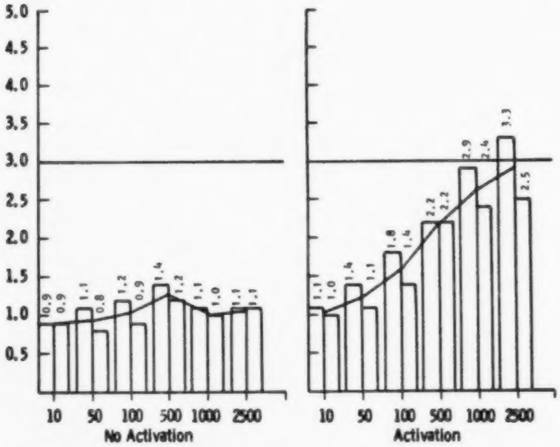


Fig. C52 – SRI AMES test data on residual oil fractions

Sample RO 12-3. Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718551-A

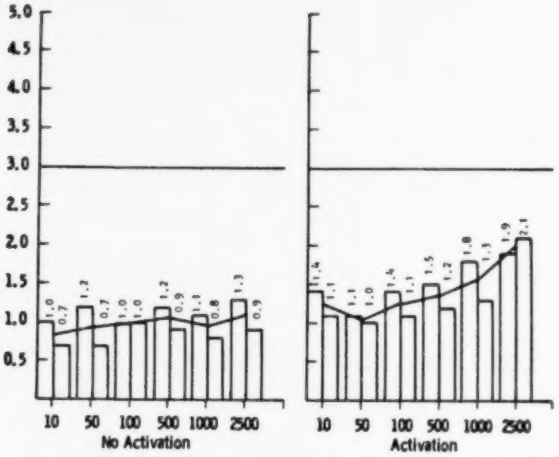


Fig. C53 – SRI AMES test data on residual oil fractions

Sample RO 12-4. Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718552-A

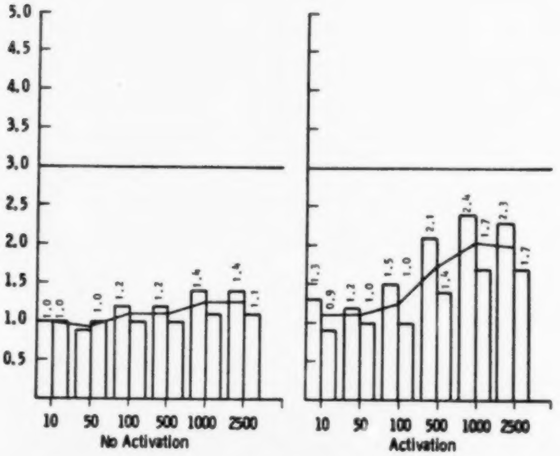


Fig. C54 – SRI AMES test data on residual oil fractions

Sample RO 12-5. Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718553-A

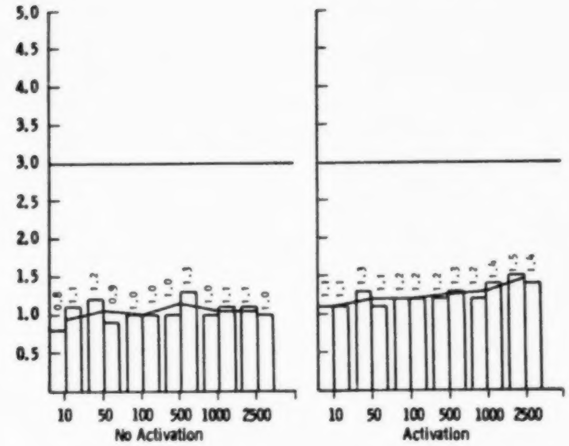


Fig. C55 – SRI AMES test data on residual oil fractions

Sample RO 12-6. Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718554-A

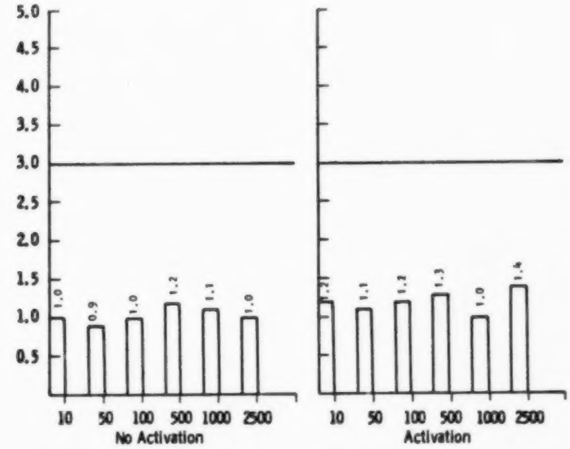


Fig. C56 – SRI AMES test data on residual oil fractions

Sample RO 12-7. Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718590-A

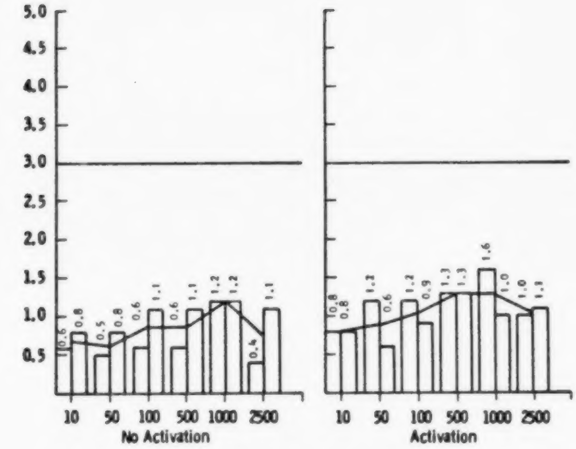


Fig. C57 – SRI AMES test data on residual oil fractions

Sample RO 5-1. Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718591-A

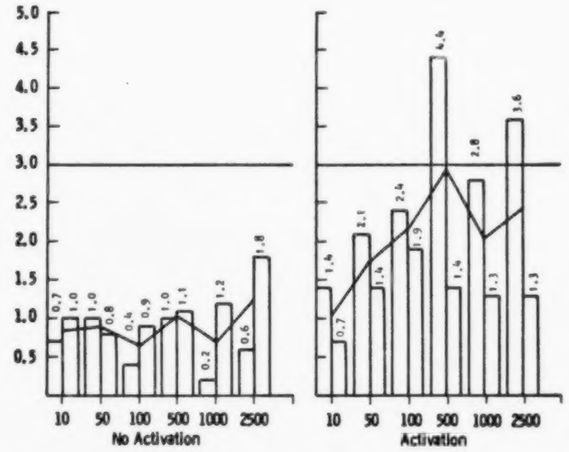


Fig. C58 – SRI AMES test data on residual oil fractions

Sample RO 5-2. Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

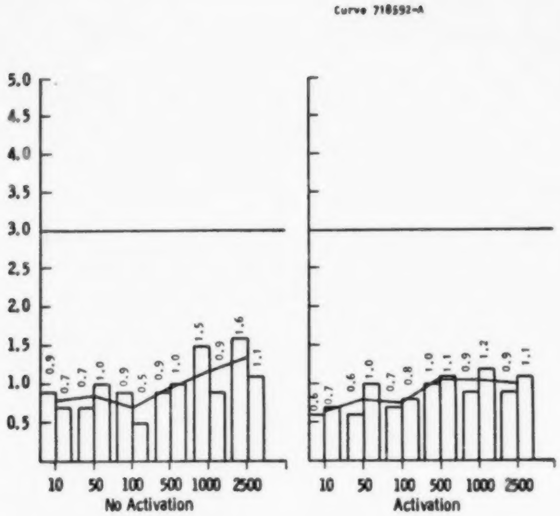


Fig. C59 – SRI AMES test data on residual oil fractions

Sample RO 5-3, Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

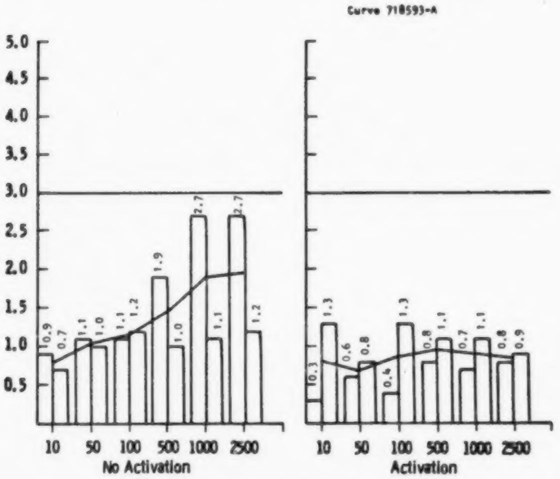


Fig. C60 – SRI AMES test data on residual oil fractions

Sample RO 5-4, Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718594-A

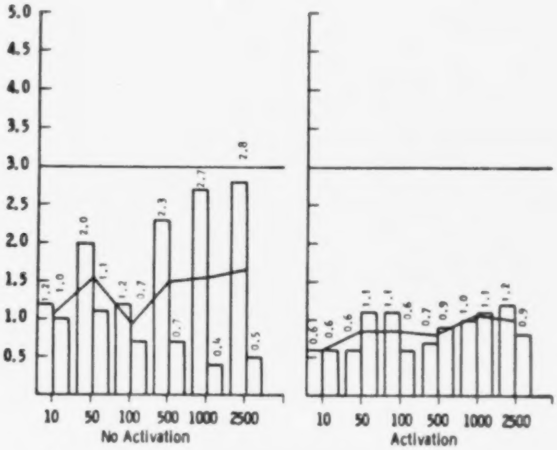


Fig.C61 – SRI AMES test data on residual oil fractions

Sample RO 5-5, Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718595-A

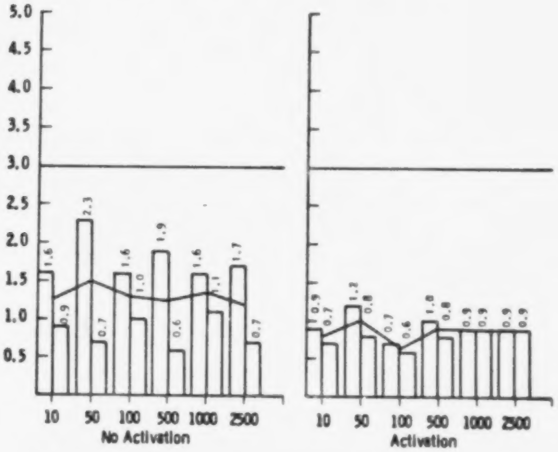


Fig.C62 – SRI AMES test data on residual oil fractions

Sample RO 5-6, Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

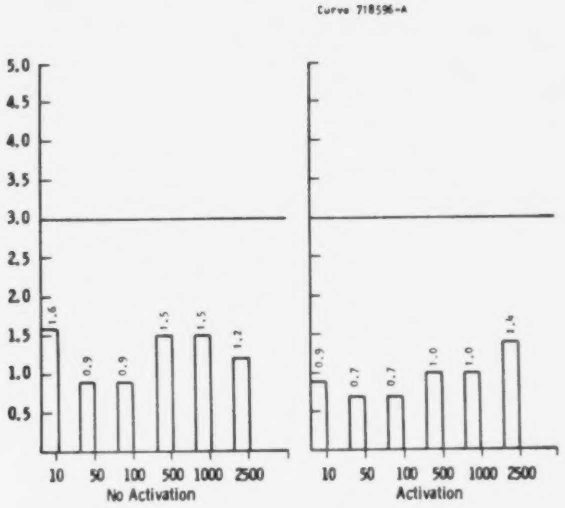


Fig.C63 – SRI AMES test data on residual oil fractions

Sample RO 5-7. Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

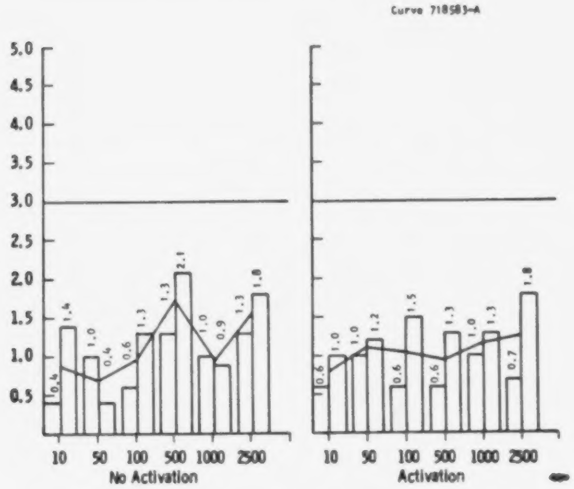


Fig.C64 – SRI AMES test data on residual oil fractions

Sample RO 5-1. Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

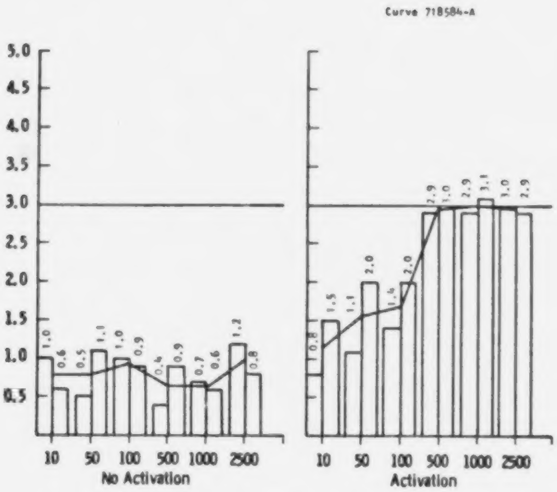


Fig.C65 – SRI AMES test data on residual oil fractions

Sample RO 5-2. Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

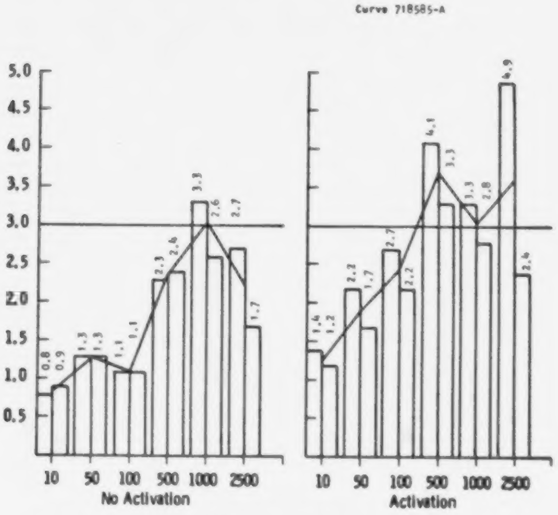


Fig.C66 – SRI AMES test data on residual oil fractions

Sample RO 5-3. Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

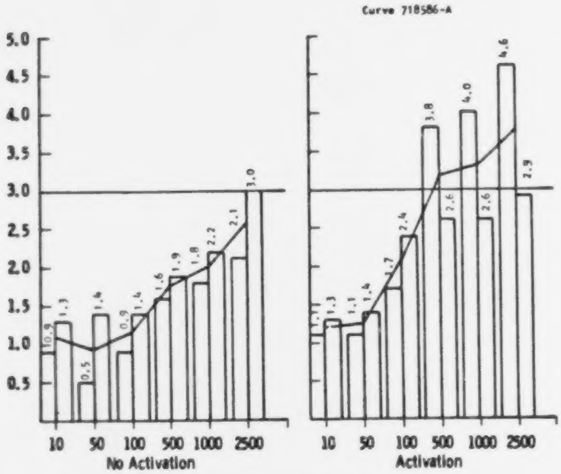


Fig. C67 – SRI AMES test data on residual oil fractions

Sample RO 5-4, Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

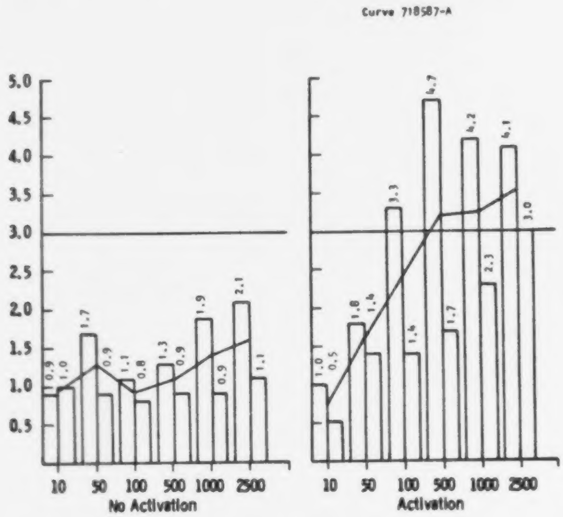


Fig. C68 – SRI AMES test data on residual oil fractions

Sample RO 5-5, Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718588-A

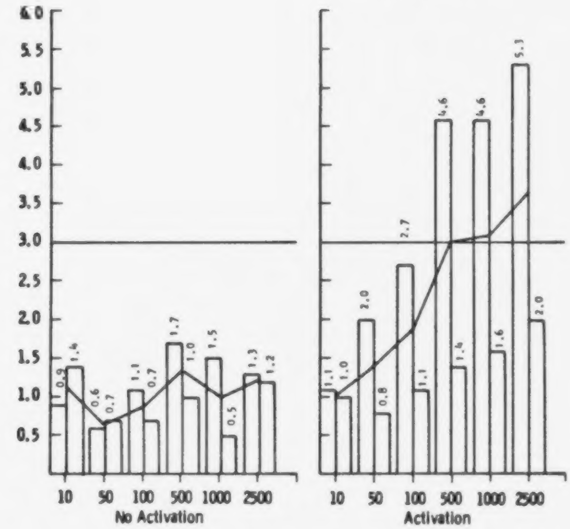


Fig. C69 – SRI AMES test data on residual oil fractions

Sample RO 5-6. Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718589-A

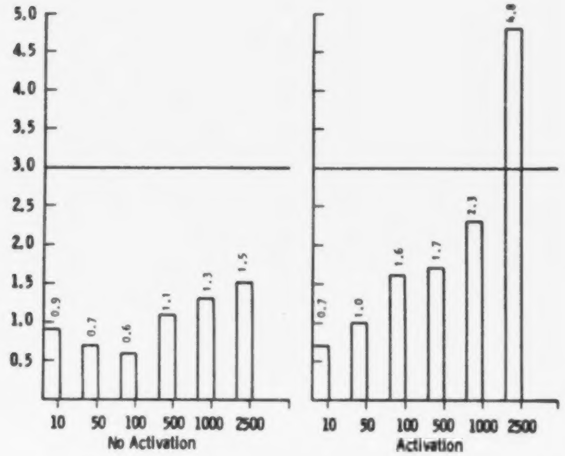


Fig. C70 – SRI AMES test data on residual oil fractions

Sample RO 5-7. Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

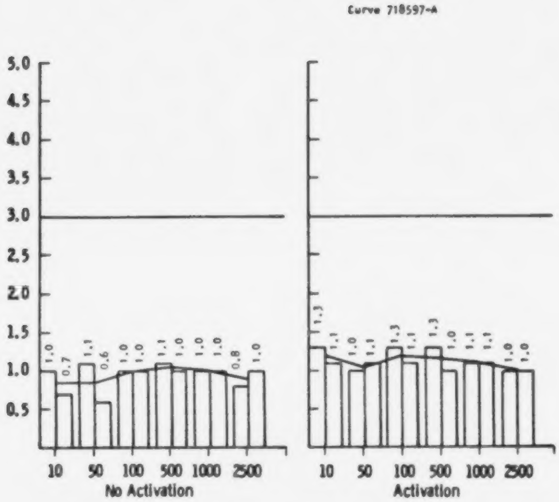


Fig. C71 – SRI AMES test data on residual oil fractions

Sample RO 5-1. Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

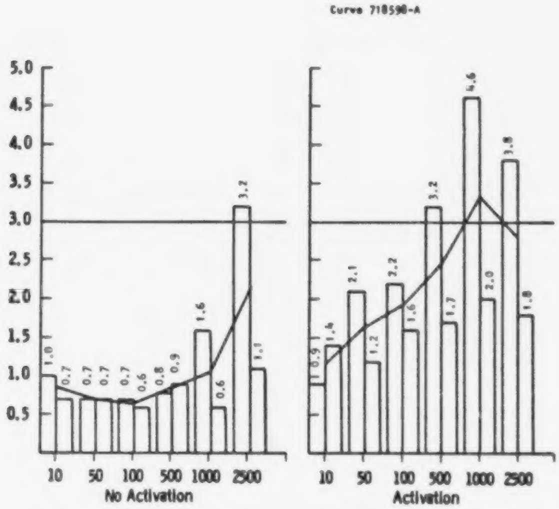


Fig. C72 – SRI AMES test data on residual oil fractions

Sample RO 5-2. Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

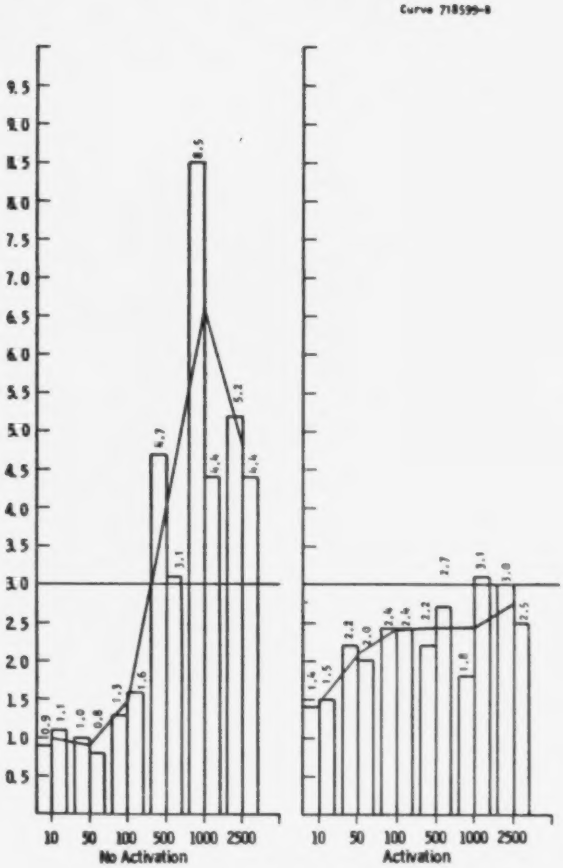
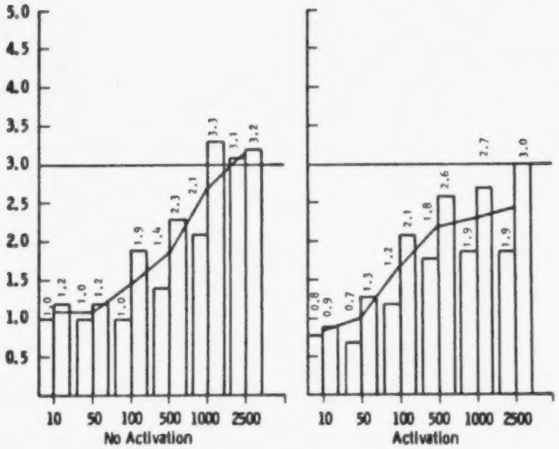


**Fig. C73— SRI AMES test data on residual oil fractions**

**Sample RO 5-3, Tester Strain TA 98**

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

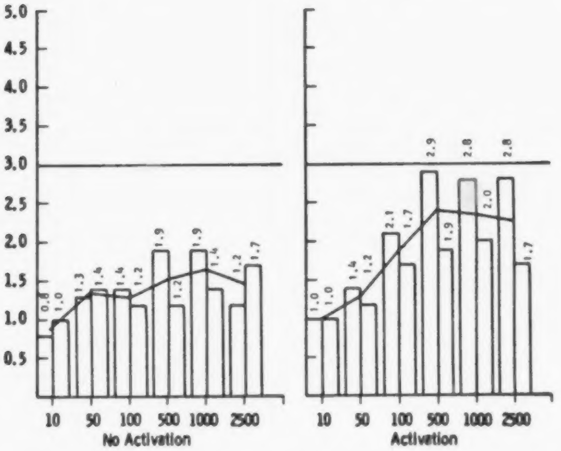


Curve 718600-A

Fig. C74 – SRI AMES test data on residual oil fractions

Sample RO 5-4, Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.



Curve 718601-A

Fig. C75 – SRI AMES test data on residual oil fractions

Sample RO 5-5, Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718602-A

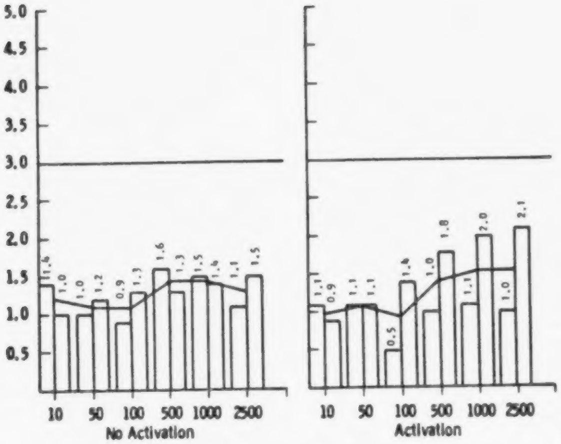


Fig. C76 – SRI AMES test data on residual oil fractions

Sample RO 5-6, Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718603-A

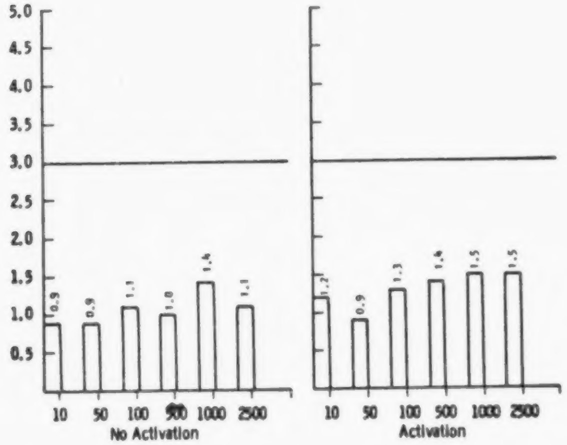


Fig. C77 – SRI AMES test data on residual oil fractions

Sample RO 5-7, Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

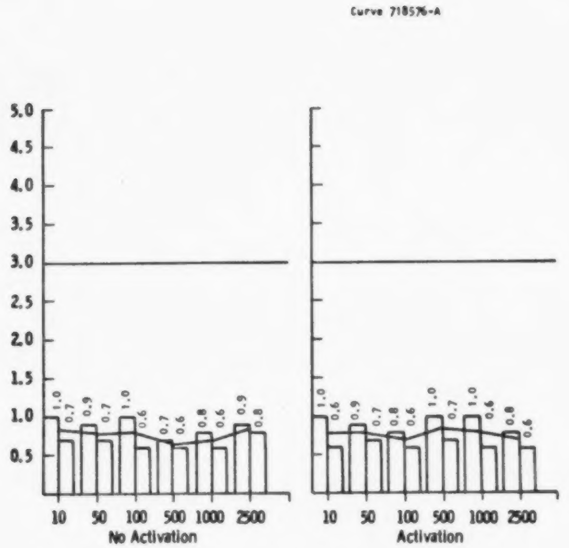


Fig. C78 – SRI AMES test data on residual oil fractions

Sample RO 5-1. Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

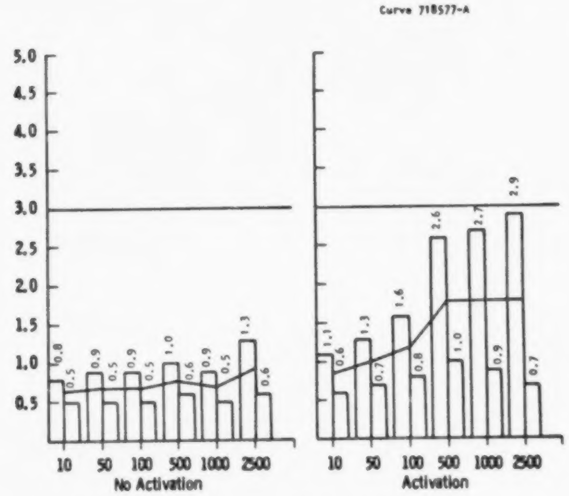


Fig. C79 – SRI AMES test data on residual oil fractions

Sample RO 5-2. Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718578-A

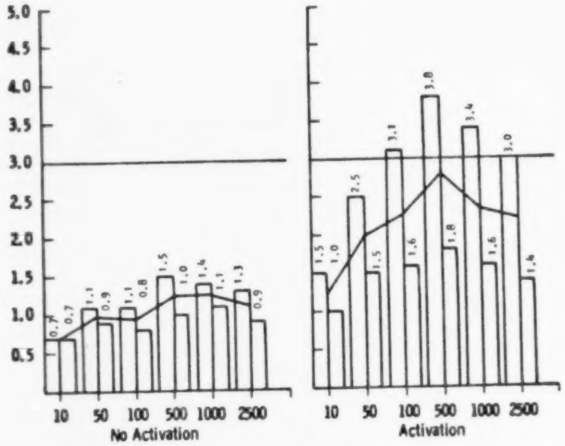


Fig.C80 – SRI AMES test data on residual oil fractions

Sample RO 5-3. Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718579-A

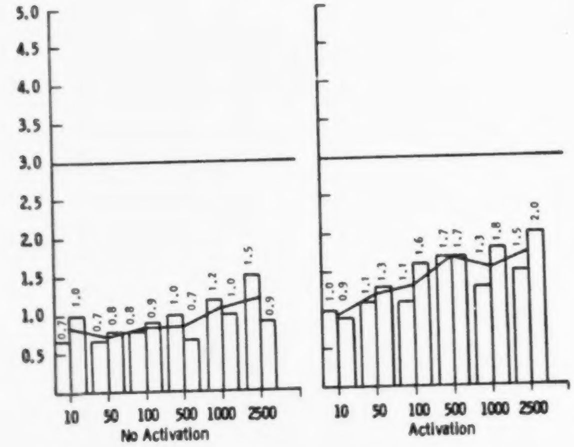


Fig.C81 – SRI AMES test data on residual oil fractions

Sample RO 5-4 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718580-A

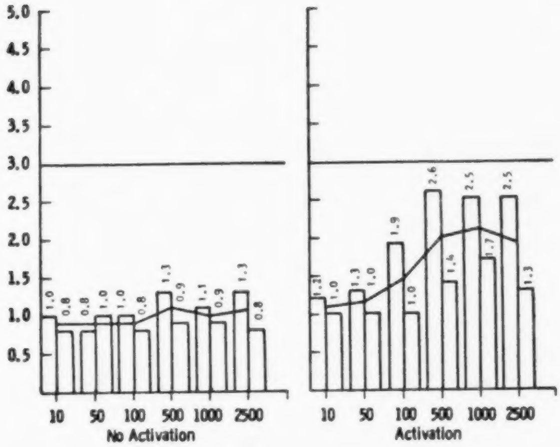


Fig. C82 – SRI AMES test data on residual oil fractions

Sample RO 5-5. Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718581-A

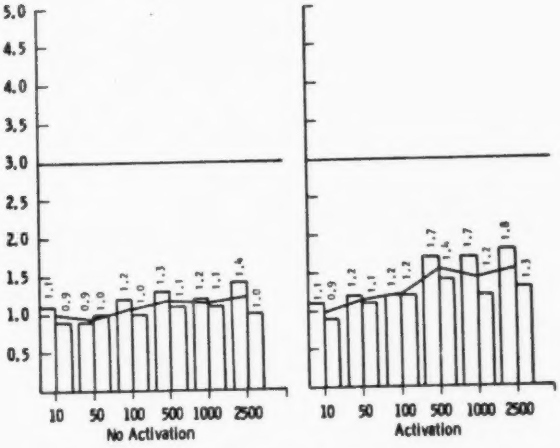


Fig. C83 – SRI AMES test data on residual oil fractions

Sample RO 5-6. Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 718582-A

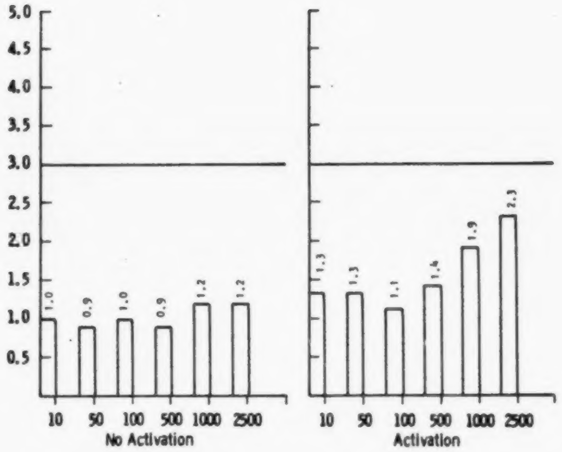


Fig. C84 – SRI AMES test data on residual oil fractions

Sample RO 5-7. Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

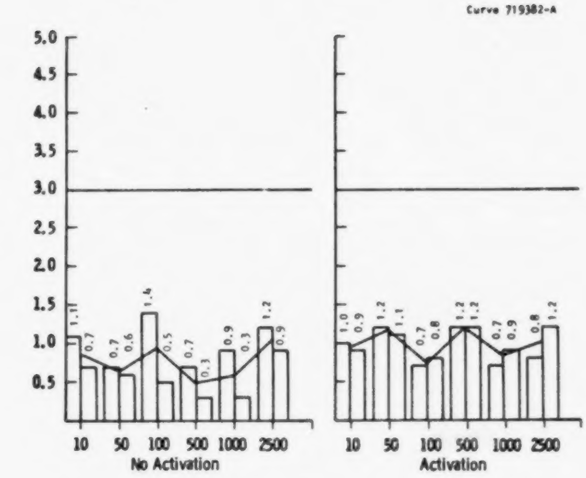


Fig. C85 – SRI AMES test data on residual oil fractions

Sample RO 14-1 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

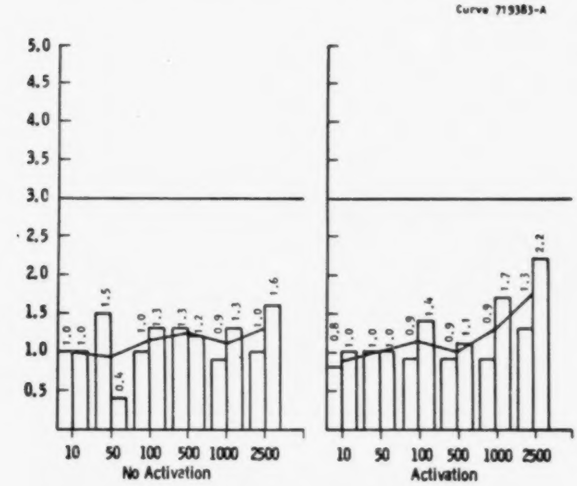


Fig. C86 – SRI AMES test data on residual oil fractions

Sample RO 14-2 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

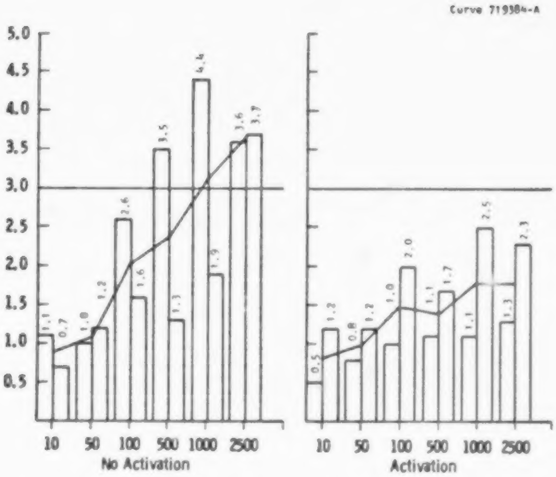


Fig. C87 – SRI AMES test data on residual oil fractions

Sample RO 14-3    Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

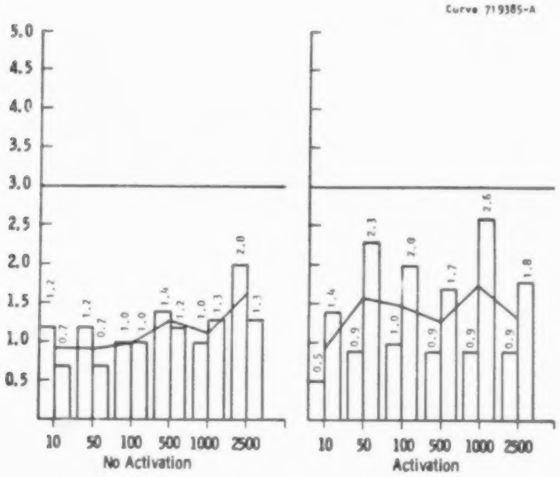


Fig. C88 – SRI AMES test data on residual oil fractions

Sample RO 14-4    Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719386-A

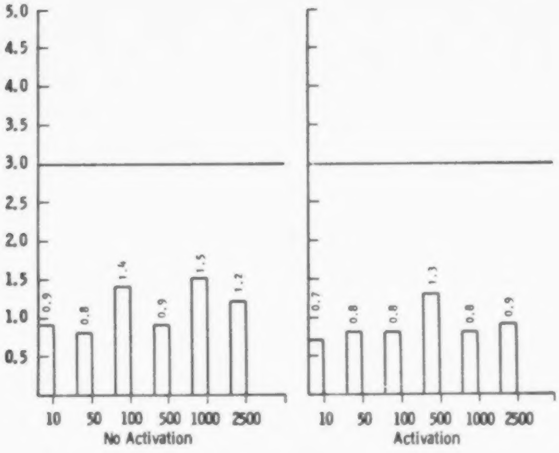


Fig. C89 — SRI AMES test data on residual oil fractions

Sample RO 14-5 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719387-A

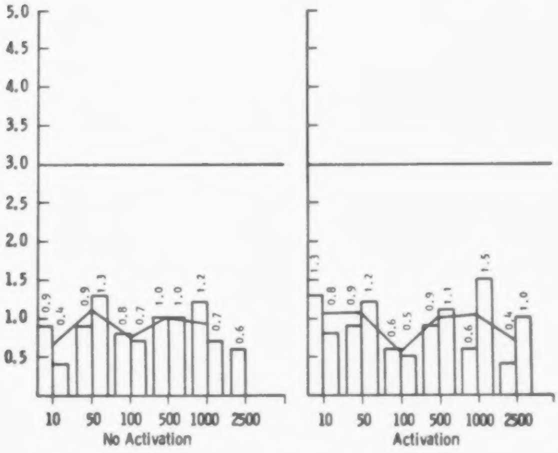


Fig. C90 — SRI AMES test data on residual oil fractions

Sample RO 14-6 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

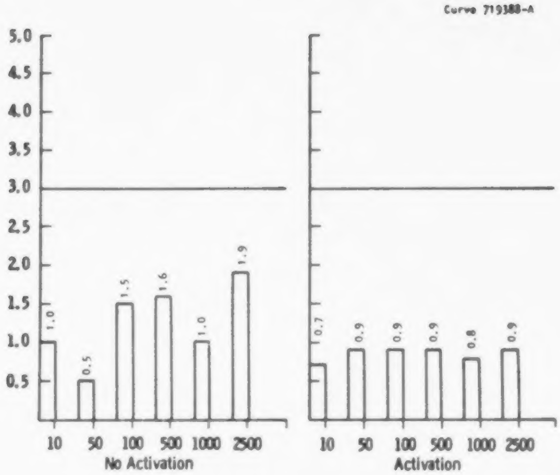


Fig. C91 – SRI AMES test data on residual oil fractions

Sample RO 14-7 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

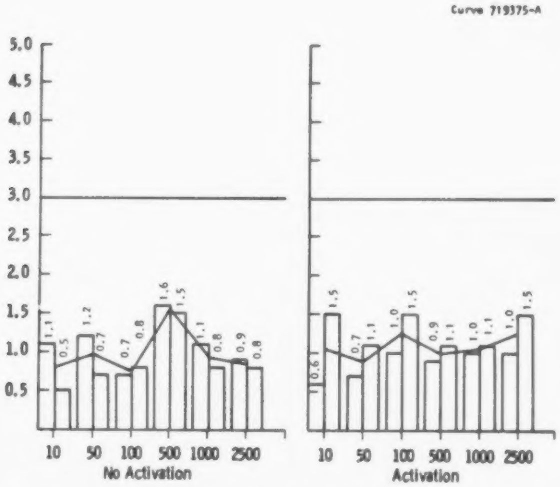


Fig. C92 – SRI AMES test data on residual oil fractions

Sample RO 14-1 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

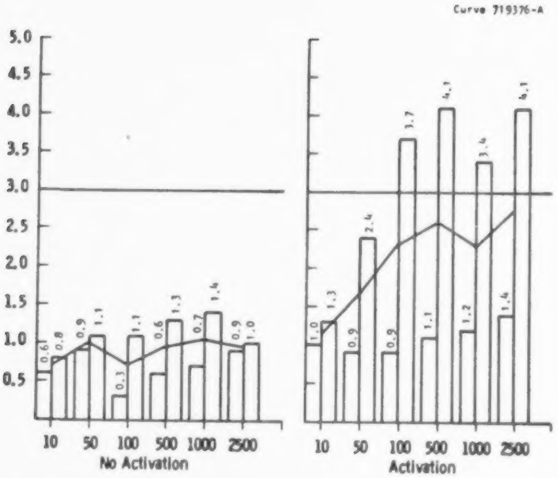


Fig.C93 – SRI AMES test data on residual oil fractions

Sample RO 14-2 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

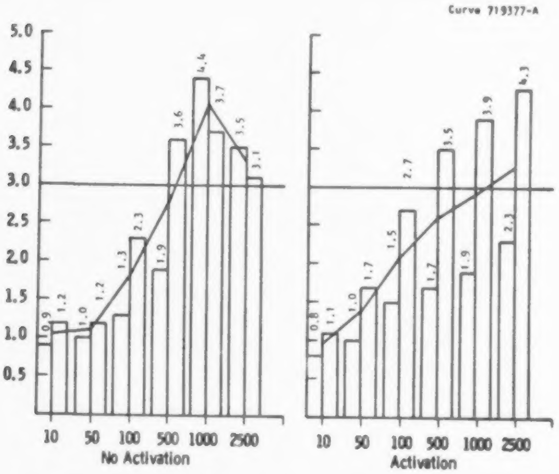


Fig.C94 – SRI AMES test data on residual oil fractions

Sample RO 14-3 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

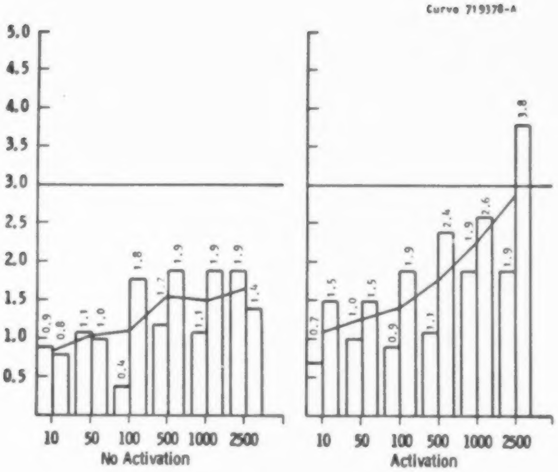


Fig. C95 – SRI AMES test data on residual oil fractions

Sample RO 14-4 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

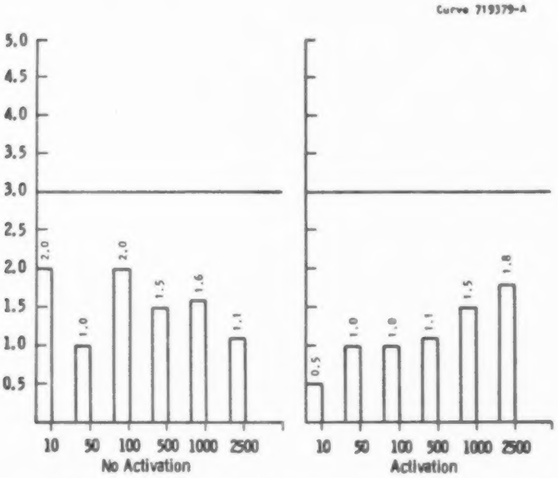


Fig. C96 – SRI AMES test data on residual oil fractions

Sample RO 14-5 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

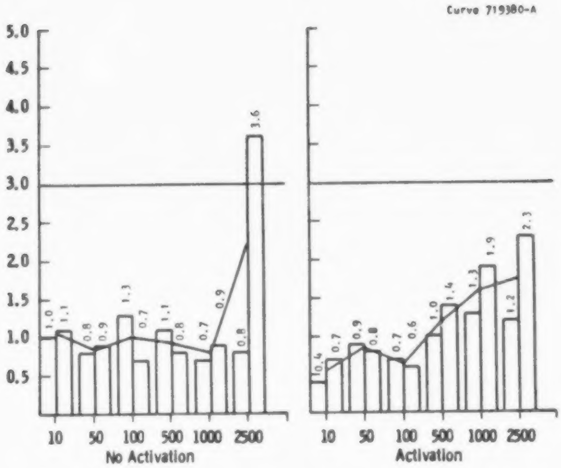


Fig. C97 – SRI AMES test data on residual oil fractions

Sample RO 14-6    Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

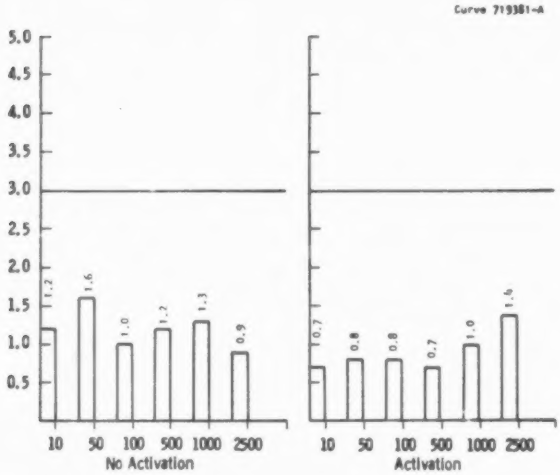


Fig. C98 – SRI AMES test data on residual oil fractions

Sample RO 14-7    Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

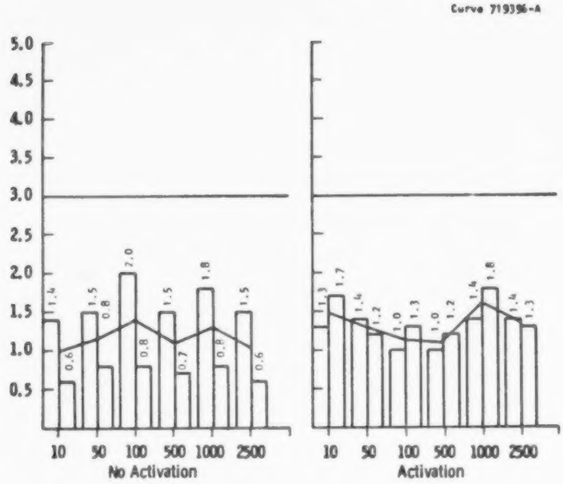


Fig. C99 – SRI AMES test data on residual oil fractions

Sample RO 14-1    Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

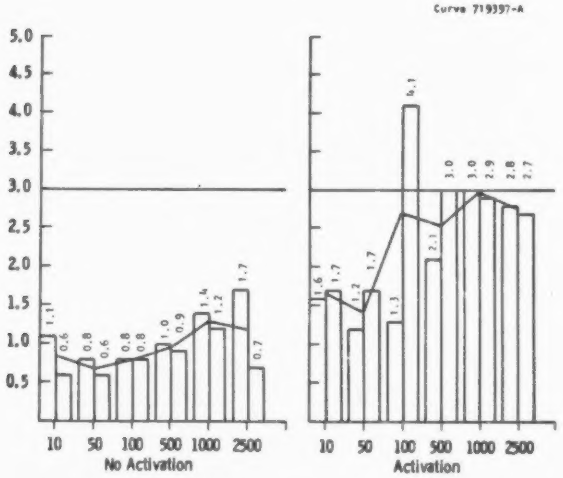


Fig. C100 – SRI AMES test data on residual oil fractions

Sample RO 14-2    Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

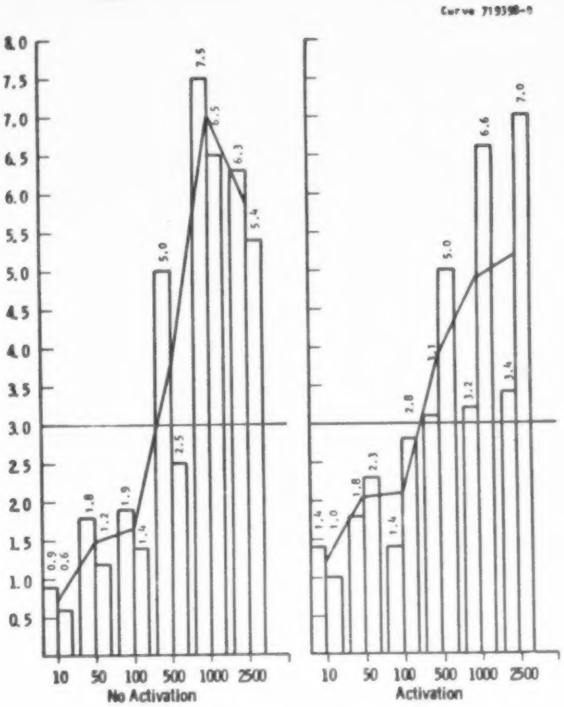


Fig. C101 – SRI AMES test data on residual oil fractions

Sample RO 14-3 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

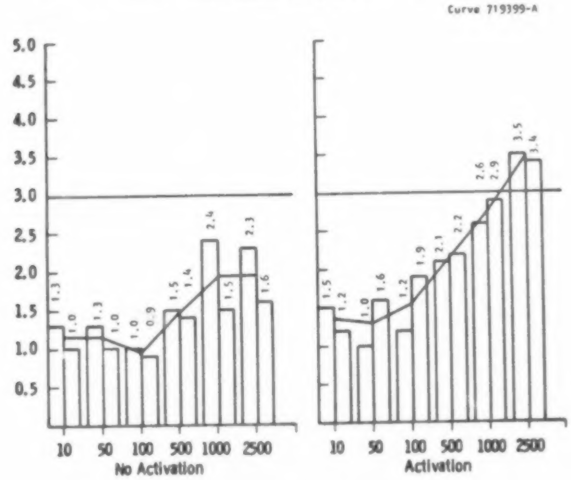


Fig. C102 – SRI AMES test data on residual oil fractions

Sample RO 14-4 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

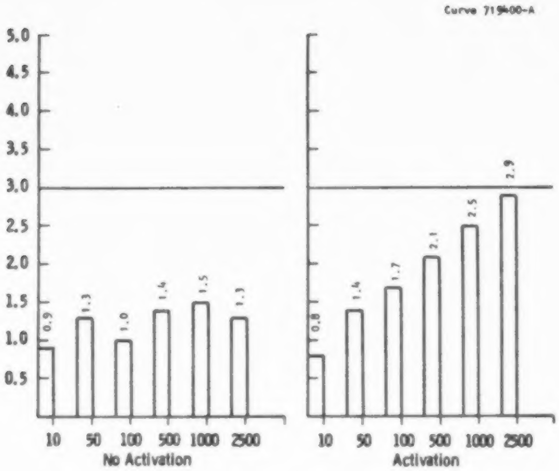


Fig. C103 — SRI AMES test data on residual oil fractions

Sample RO 14-5 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

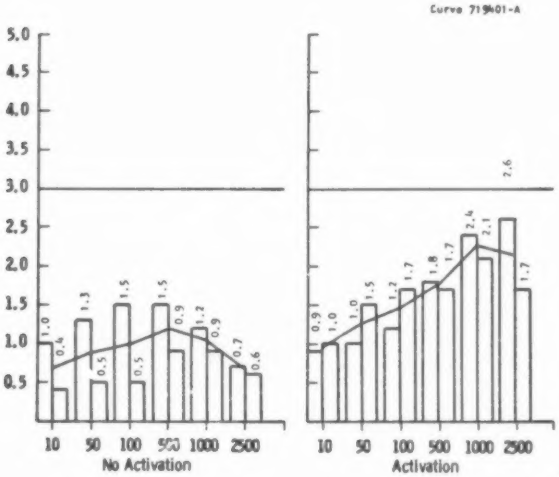


Fig. C104 — SRI AMES test data on residual oil fractions

Sample RO 14-6 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

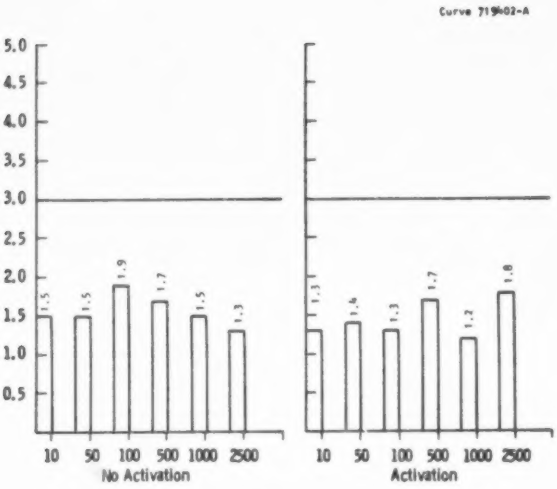


Fig. C105 — SRI AMES test data on residual oil fractions

Sample RO 14-7 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

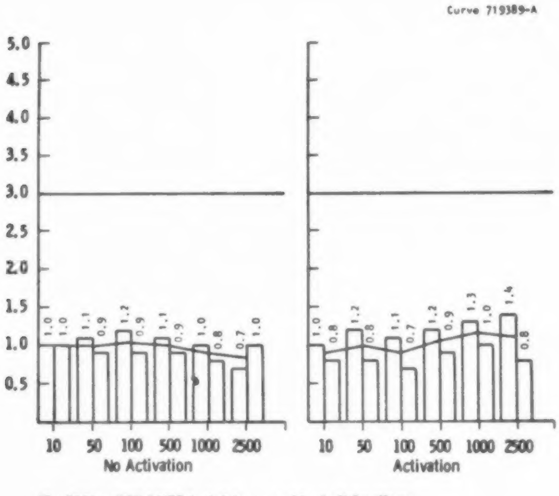


Fig. C106 — SRI AMES test data on residual oil fractions

Sample RO 14-1 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

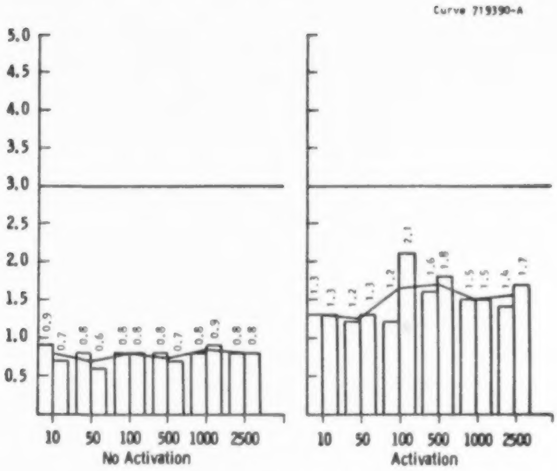


Fig. C107 – SRI AMES test data on residual oil fractions

Sample RO 14-2 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

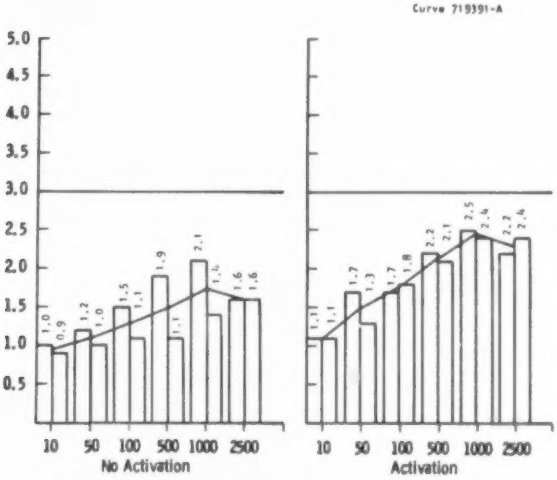


Fig. C108 – SRI AMES test data on residual oil fractions

Sample RO 14-3 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

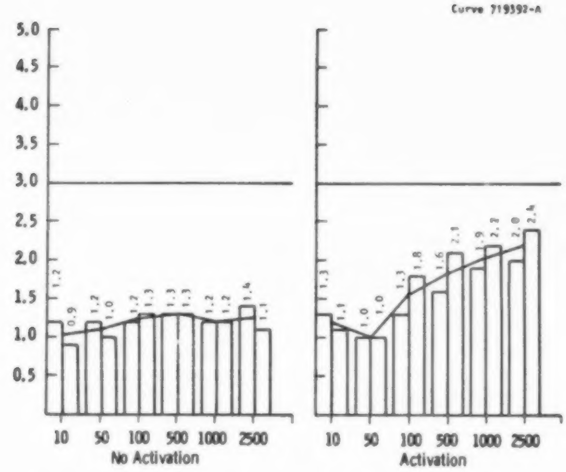


Fig.C109 — SRI AMES test data on residual oil fractions

Sample RO 14-4 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

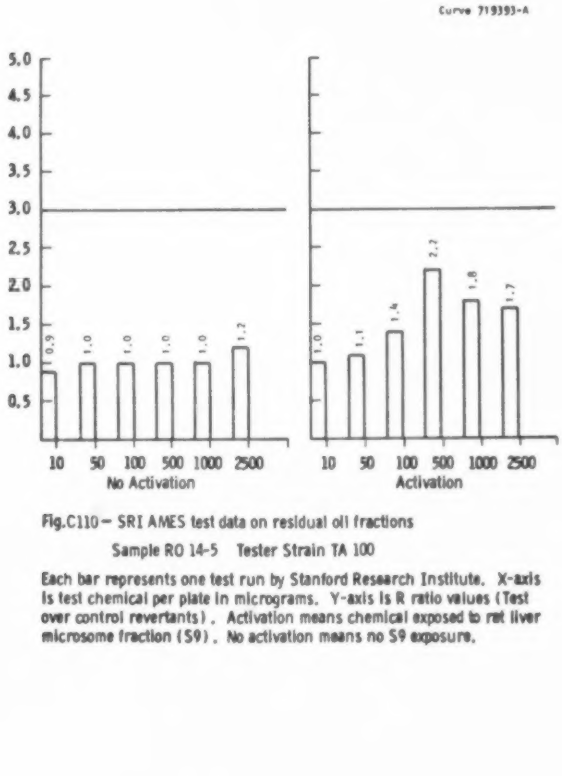


Fig.C110 — SRI AMES test data on residual oil fractions

Sample RO 14-5 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

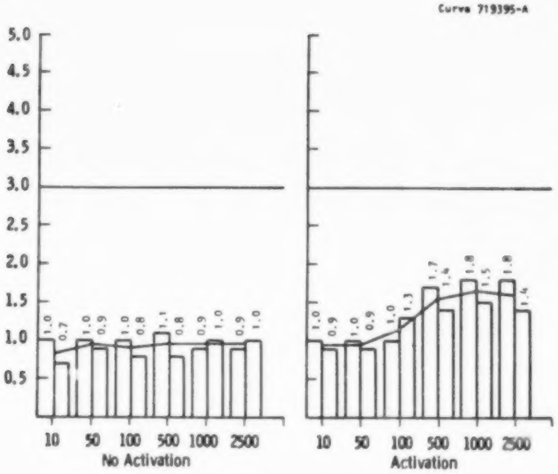


Fig. C111 – SRI AMES test data on residual oil fractions

Sample RO 14-6 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

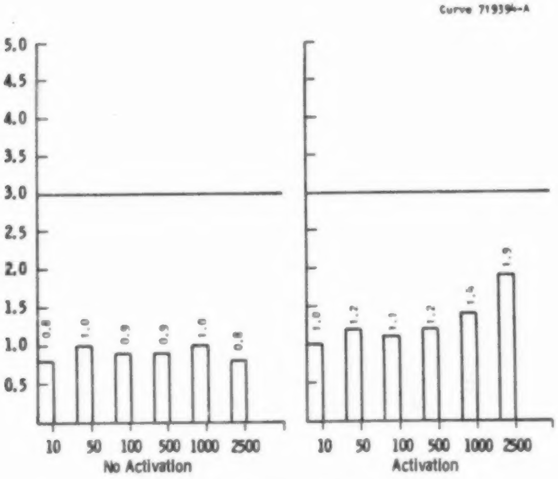


Fig. C112 – SRI AMES test data on residual oil fractions

Sample RO 14-7 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

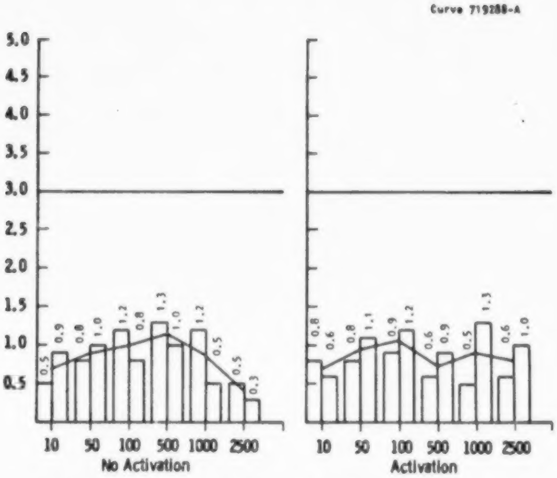


Fig. C113 – SRI AMES test data on residual oil fractions

Sample RO 15-1    Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

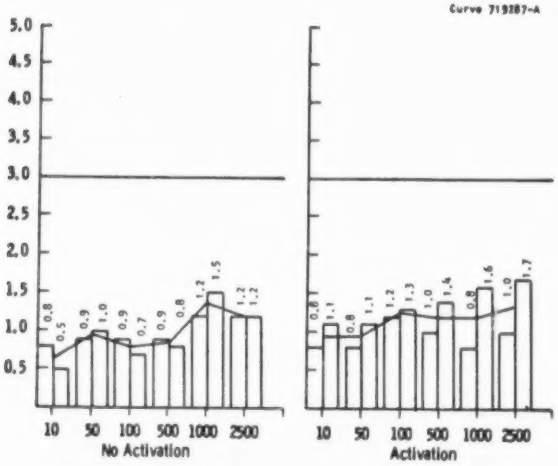


Fig. C114 – SRI AMES test data on residual oil fractions

Sample RO 15-2    Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

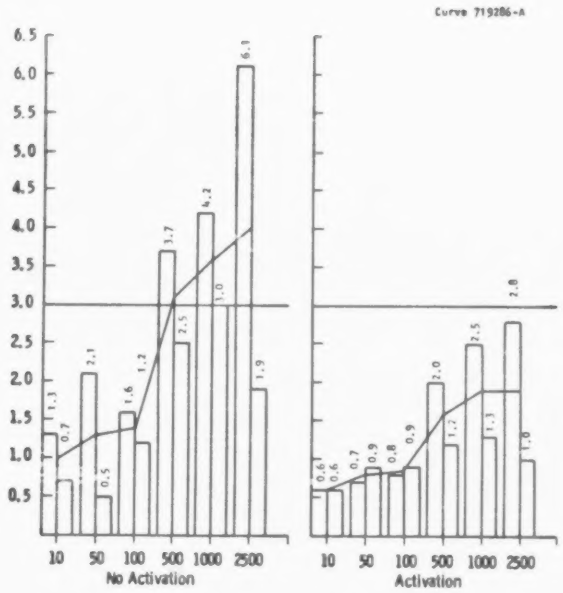


Fig. C115 – SRI AMES test data on residual oil fractions

Sample RO 15-3 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

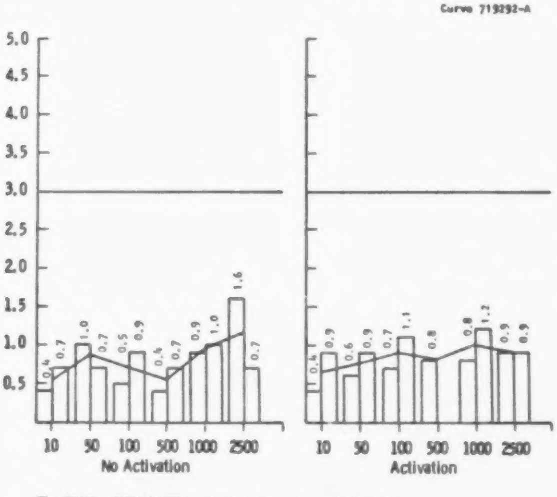


Fig. C116 – SRI AMES test data on residual oil fractions

Sample RO 15-4 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719291-A

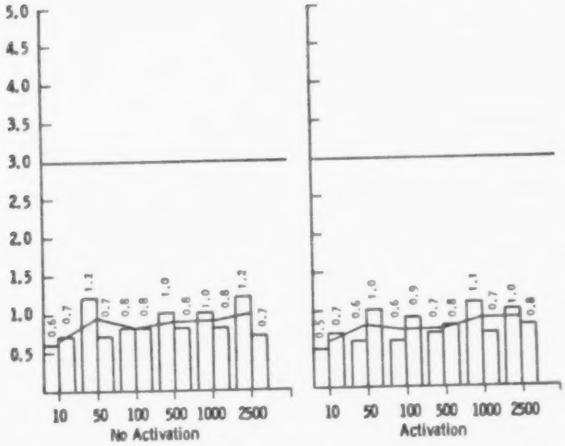


Fig. C117 – SRI AMES test data on residual oil fractions

Sample RO 15-5 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719290-A

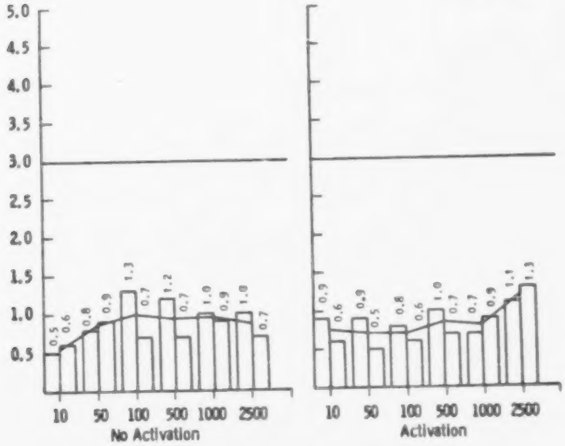


Fig. C118 – SRI AMES test data on residual oil fractions

Sample RO 15-6 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

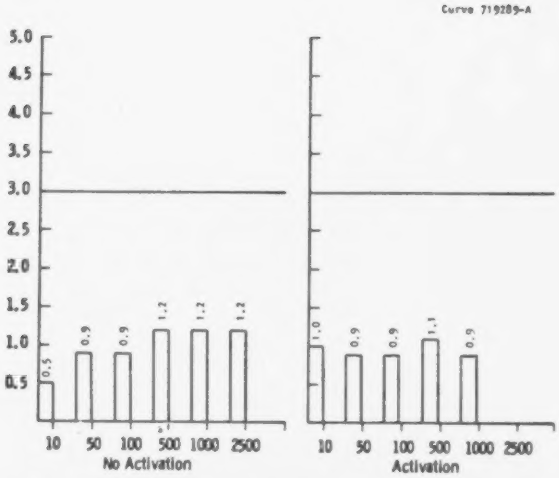


Fig. C119 — SRI AMES test data on residual oil fractions

Sample RO 15-7 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

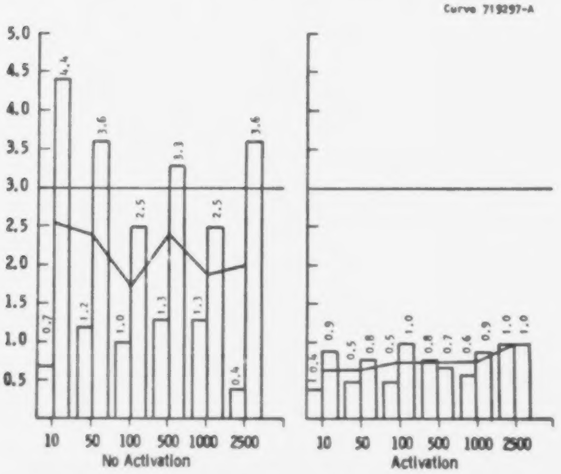
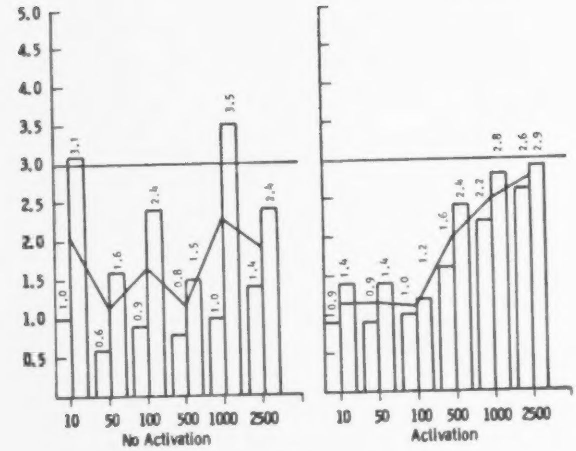


Fig. C120 — SRI AMES test data on residual oil fractions

Sample RO 15-1 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.



Curve 719298-A

Fig.C121 – SRI AMES test data on residual oil fractions

Sample RO 15-2   Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

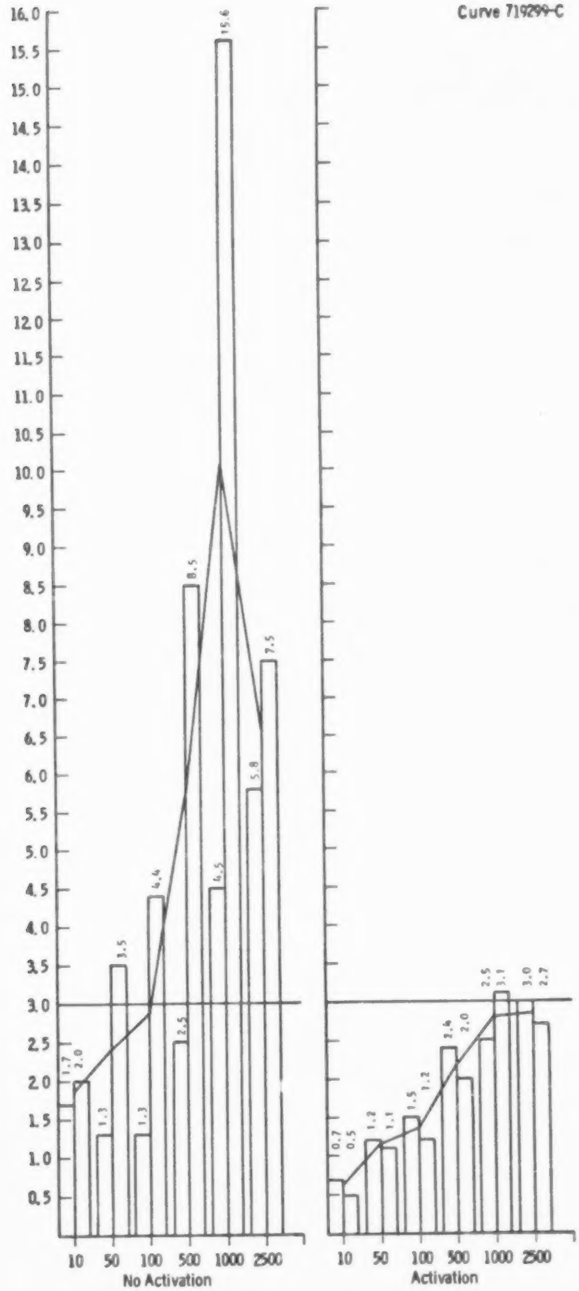


Fig. C122 – SRI AMES test data on residual oil fractions

Sample RO 15-3 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis if R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

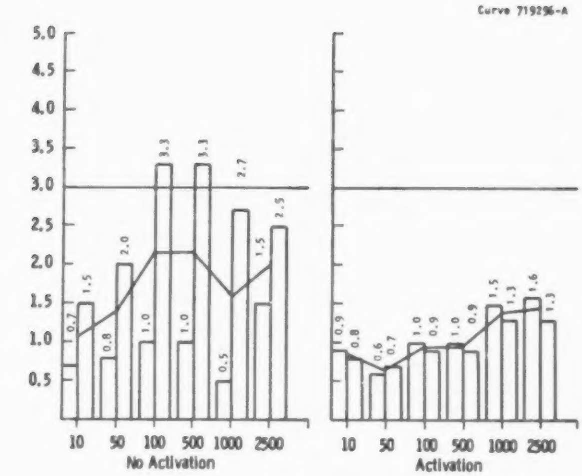


Fig. C123 — SRI AMES test data on residual oil fractions

Sample RO 15-4 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

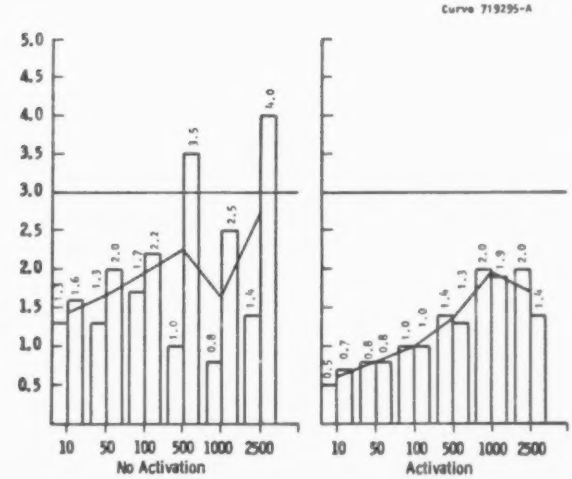


Fig. C124 — SRI AMES test data on residual oil fractions

Sample RO 15-5 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

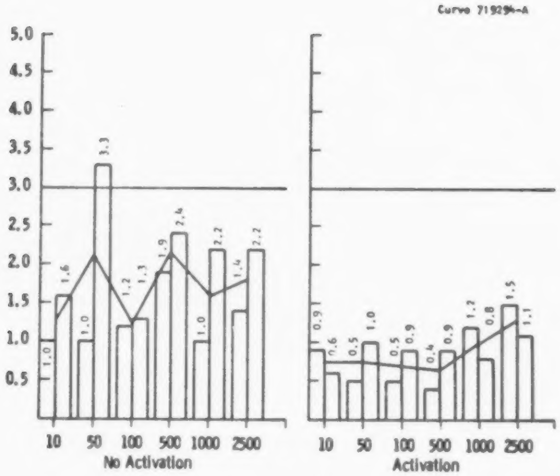


Fig. C125 – SRI AMES test data on residual oil fractions

Sample RO 15-6 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

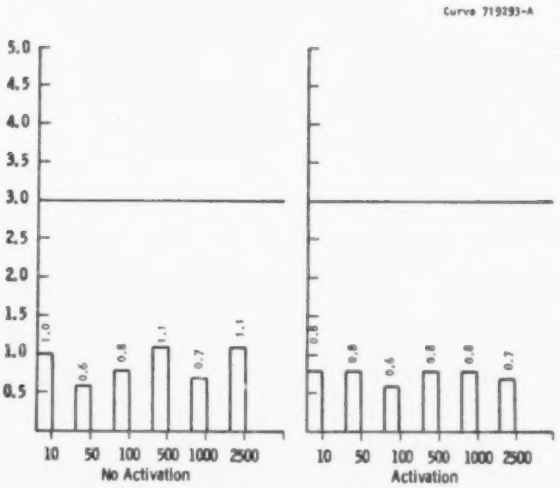


Fig. C126 – SRI AMES test data on residual oil fractions

Sample RO 15-7 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

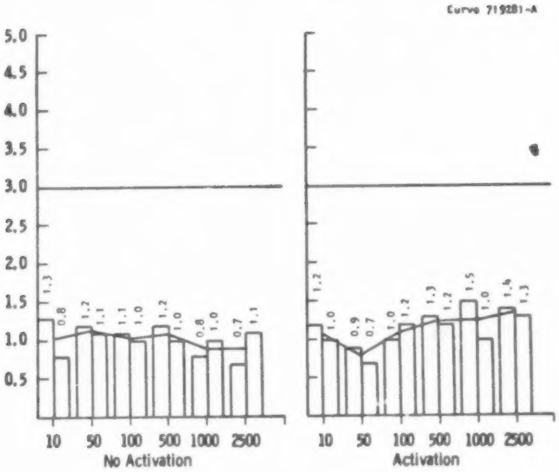


Fig. C127 — SRI AMES test data on residual oil fractions

Sample RO 15-1 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

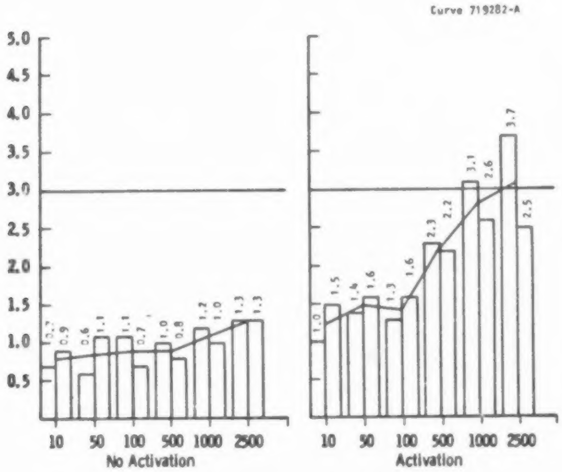


Fig. C128 — SRI AMES test data on residual oil fractions

Sample RO 15-2 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719285-B

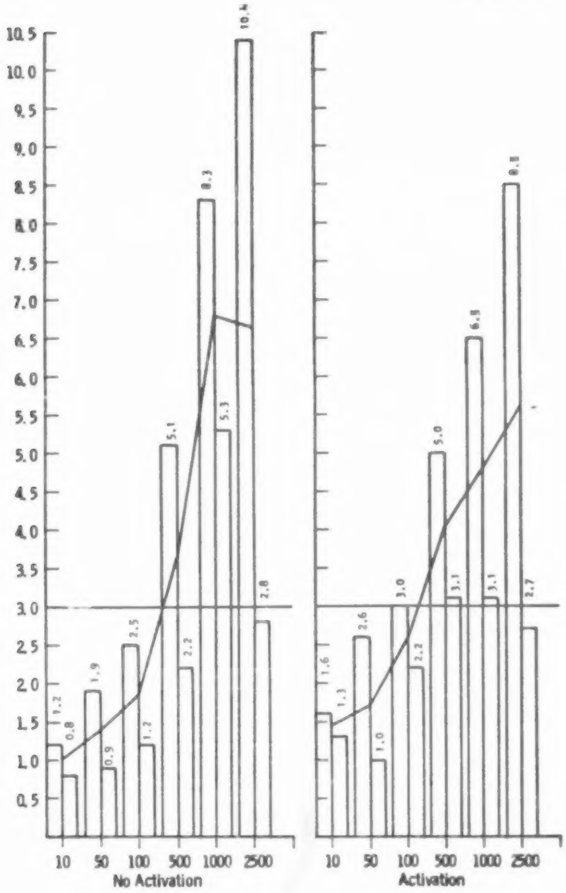


Fig. C129 — SRI AMES test data on residual oil fractions

Sample RO 15-3 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

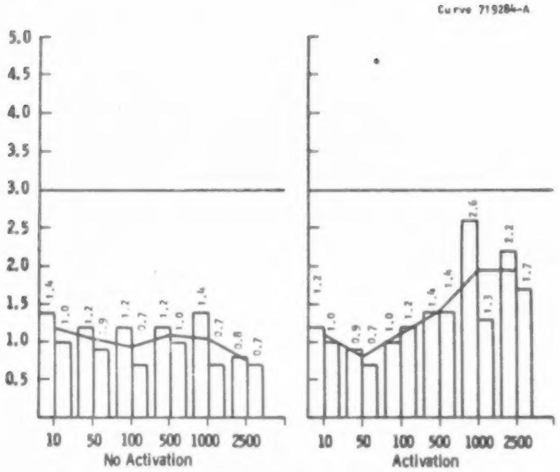


Fig. C130 — SRI AMES test data on residual oil fractions

Sample RO 15-4 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

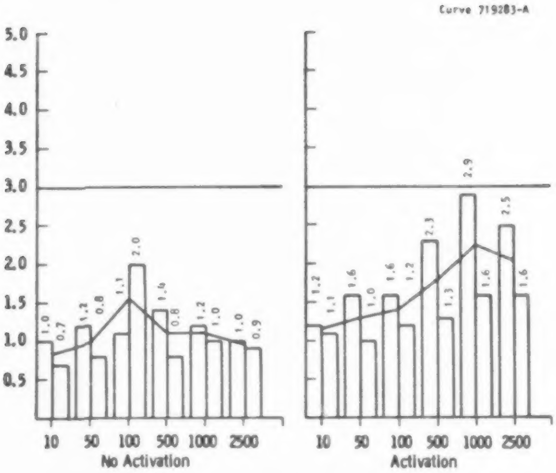


Fig. C131 – SRI AMES test data on residual oil fractions

Sample RO 15-5 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

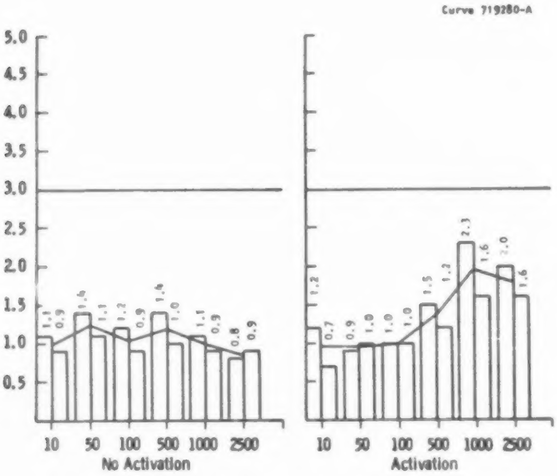


Fig. C132 – SRI AMES test data on residual oil fractions

Sample RO 15-6 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719279-A

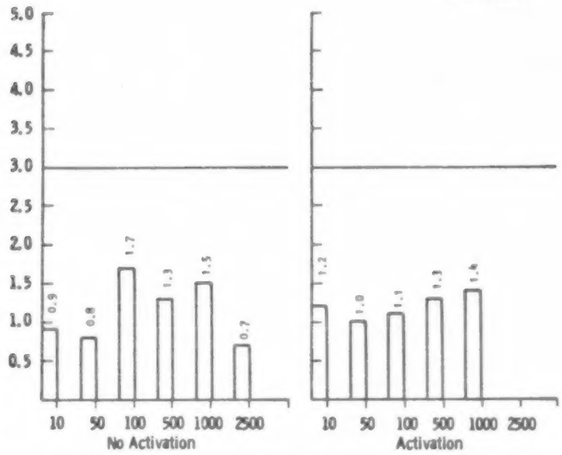


Fig. C133 – SRI AMES test data on residual oil fractions

Sample RO 15-7    Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719272-A

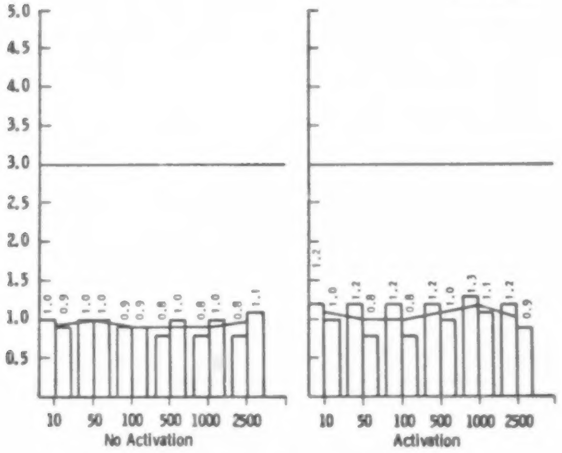


Fig. C134 – SRI AMES test data on residual oil fractions

Sample RO 15-1    Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

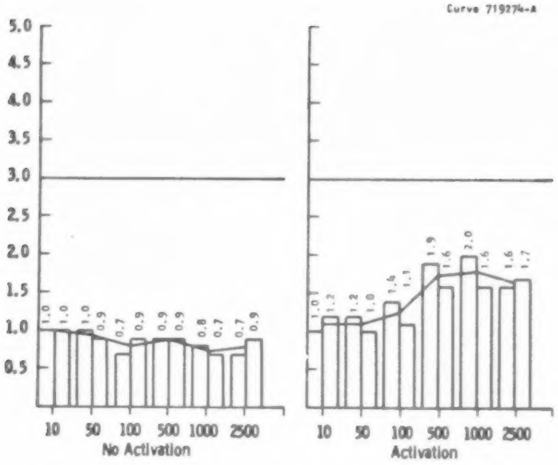


Fig. C135 — SRI AMES test data on residual oil fractions

Sample RO 15-2 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

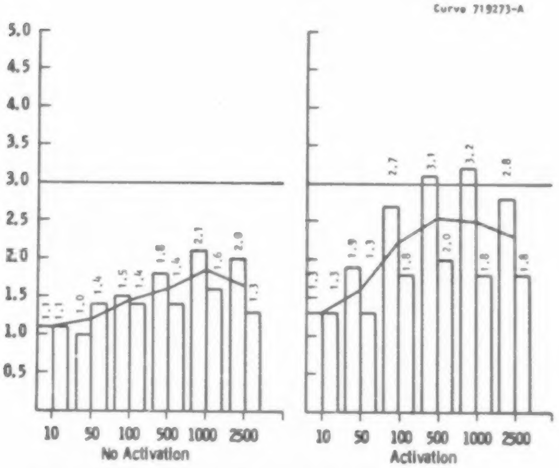


Fig. C136 — SRI AMES test data on residual oil fractions

Sample RO 15-3 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719278-A

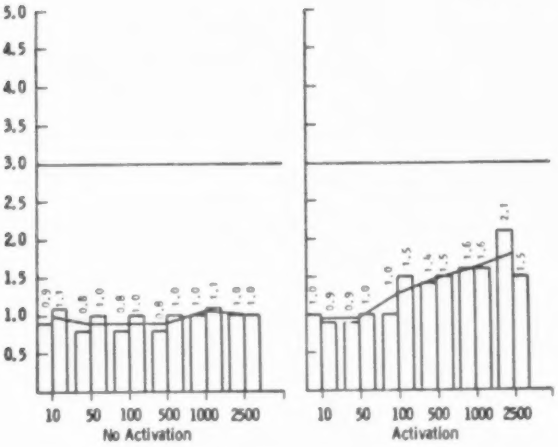


Fig. C137 – SRI AMES test data on residual oil fractions

Sample RO 15-4 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719277-A

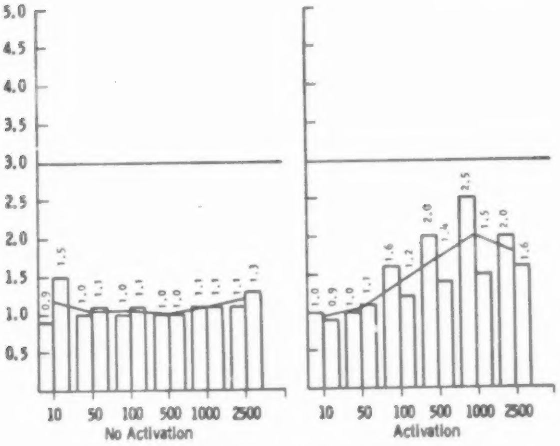


Fig. C138 – SRI AMES test data on residual oil fractions

Sample RO 15-5 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

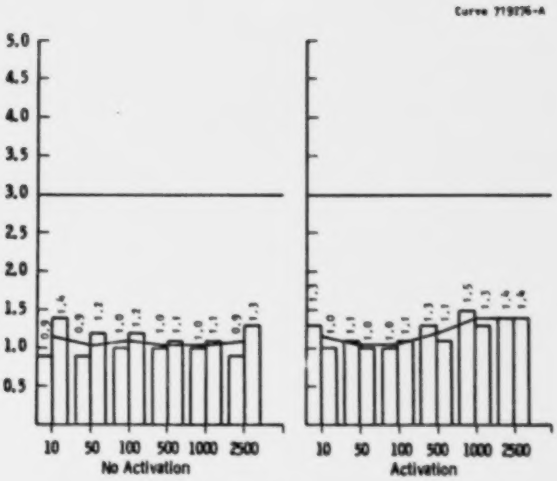


Fig.C139 — SRI AMES test data on residual oil fractions

Sample RO 15-6 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

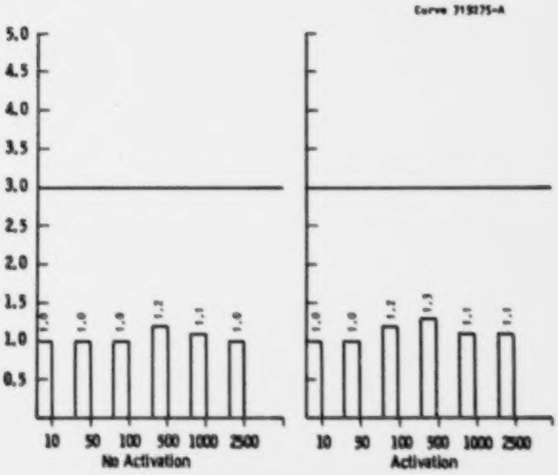


Fig.C140 — SRI AMES test data on residual oil fractions

Sample RO 15-7 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

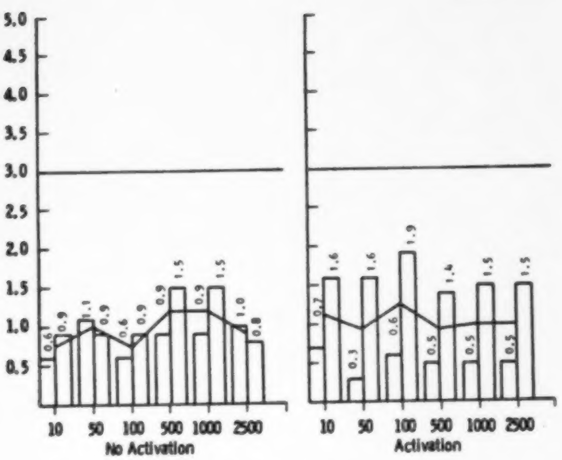


Fig. C141 – SRI AMES test data on residual oil fractions

Sample RO 16-1  Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

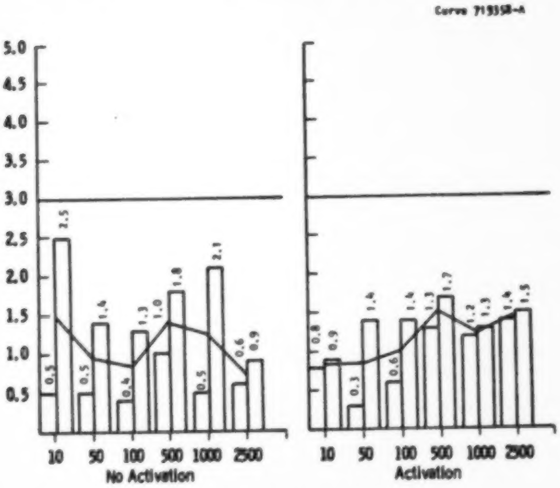


Fig. C142 – SRI AMES test data on residual oil fractions

Sample RO 16-2  Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719355-A

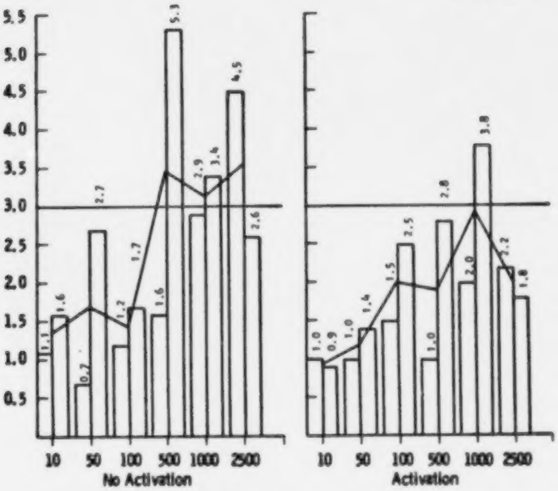


Fig.C143 – SRI AMES test data on residual oil fractions

Sample RO 16-3 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719356-A

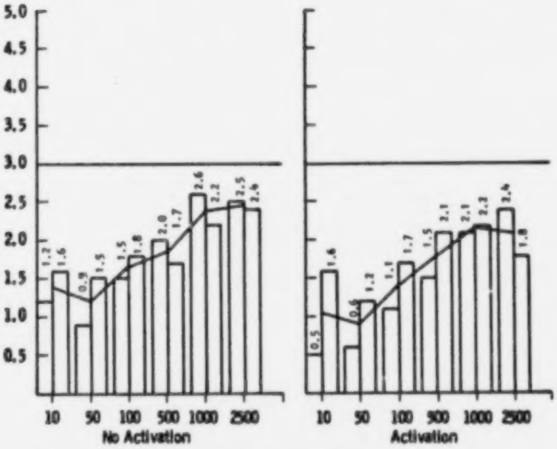


Fig.C144 – SRI AMES test data on residual oil fractions

Sample RO 16-4 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719359-A

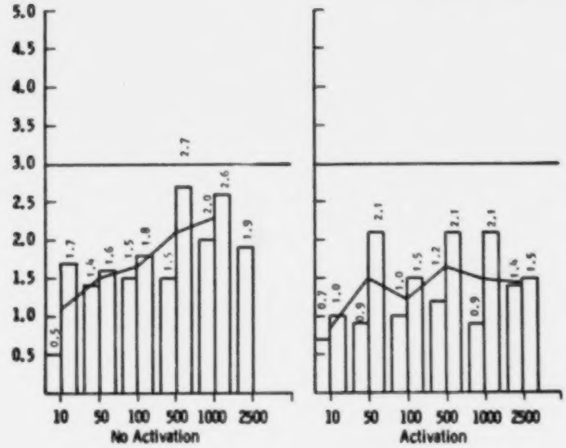


Fig. C145 – SRI AMES test data on residual fractions

Sample RO 16-5    Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719361-A

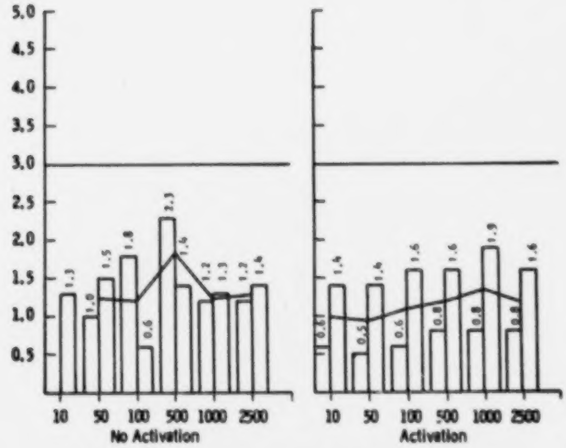


Fig. C146 – SRI AMES test data on residual oil fractions

Sample RO 16-6    Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

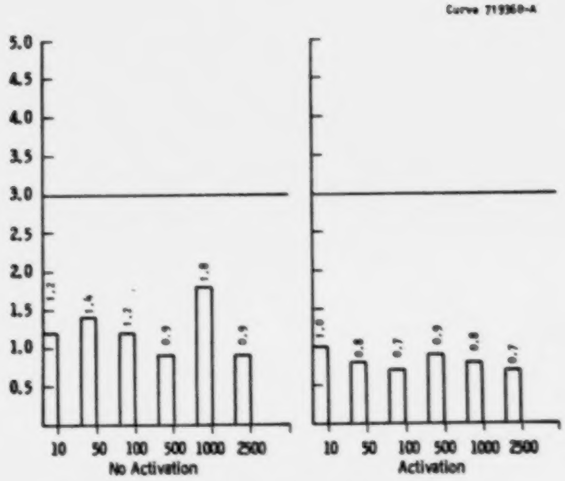


Fig. C147 – SRI AMES test data on residual fractions

Sample RO 16-7 Tester Strain TA 1537

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

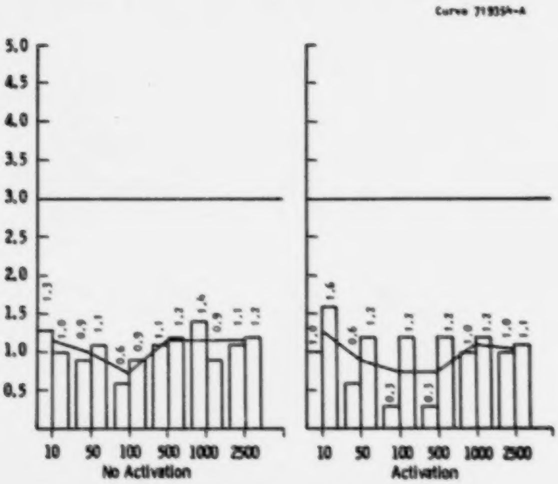


Fig. C148 – SRI AMES test data on residual oil fractions

Sample RO 16-1 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

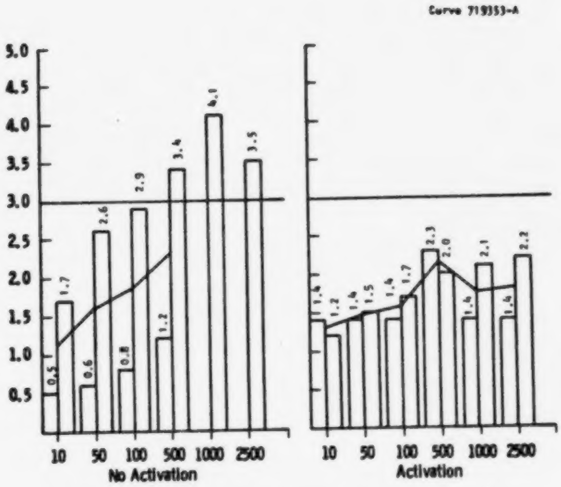


Fig. C149 – SRI AMES test data on residual oil fractions

Sample RO 16-2 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

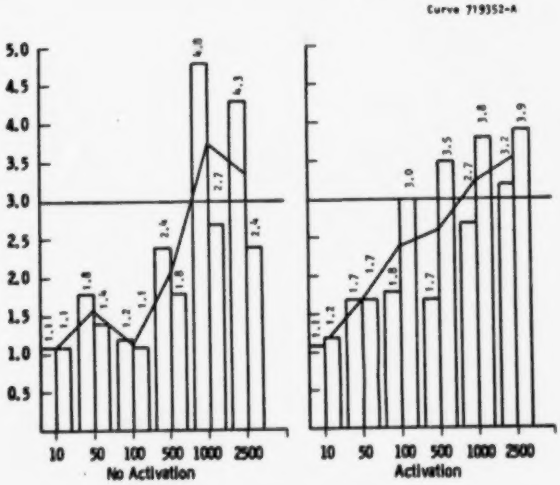


Fig. C150 – SRI AMES test data on residual oil fractions

Sample RO 16-3 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

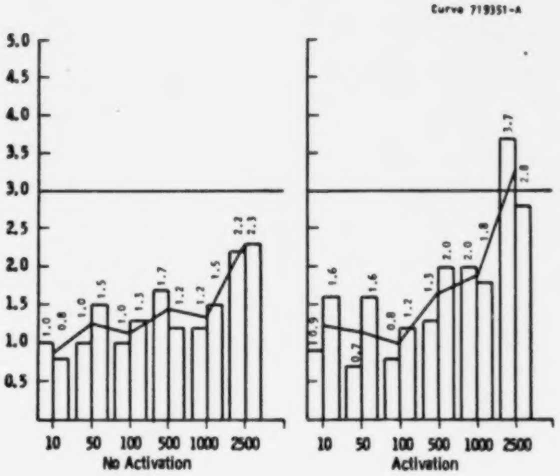


Fig. C151 — SRI AMES test data on residual oil fractions

Sample RO 16-4 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

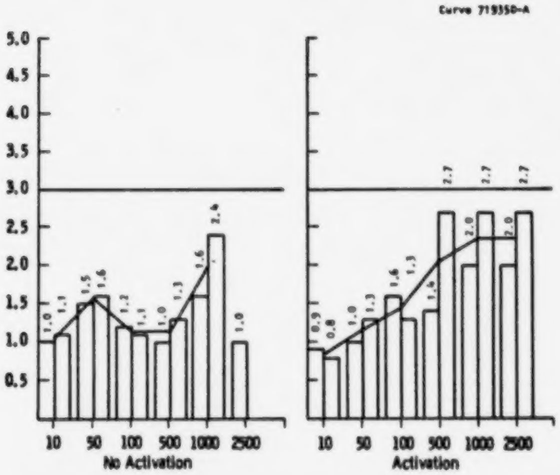


Fig. C152 — SRI AMES test data on residual oil fractions

Sample RO 16-5 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

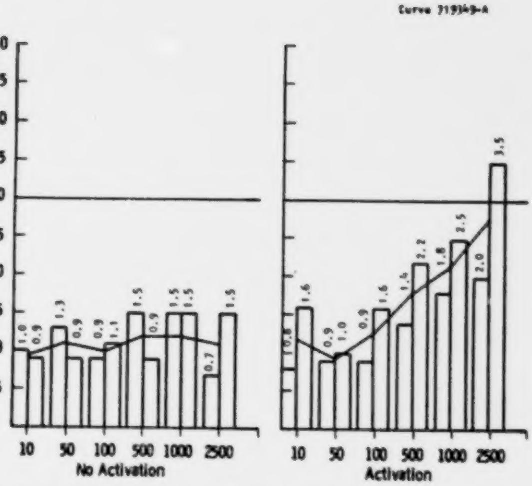


Fig. C153 – SRI AMES test data on residual oil fractions

Sample RO 16-6 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

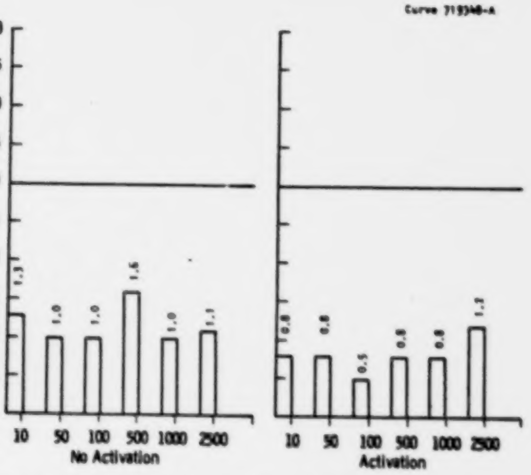


Fig. C154 – SRI AMES test data on residual oil fractions

Sample RO 16-7 Tester Strain TA 1538

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

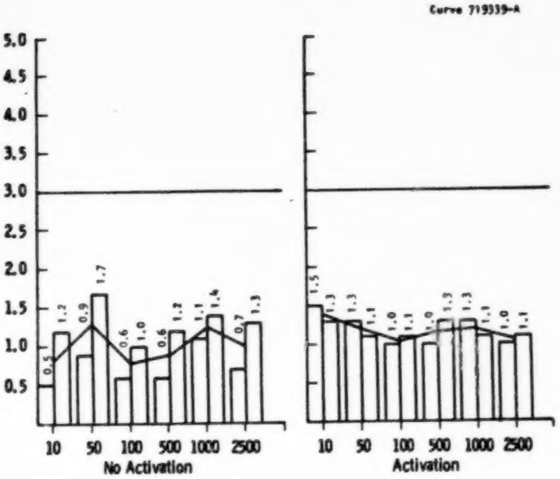


Fig. C155 – SRI AMES test data on residual oil fractions

Sample RO 16-1    Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

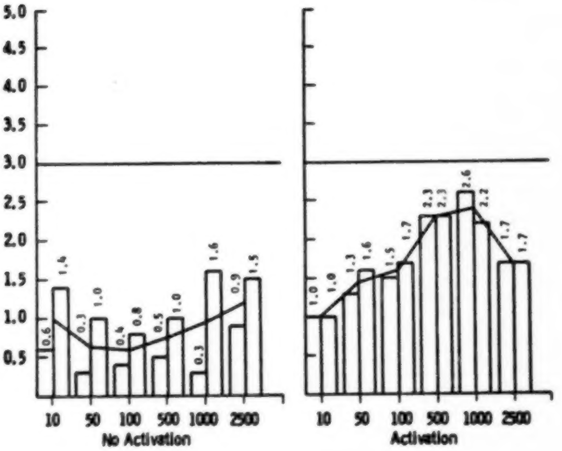


Fig. C156 – SRI AMES test data on residual oil fractions

Sample RO 16-2    Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719340-B

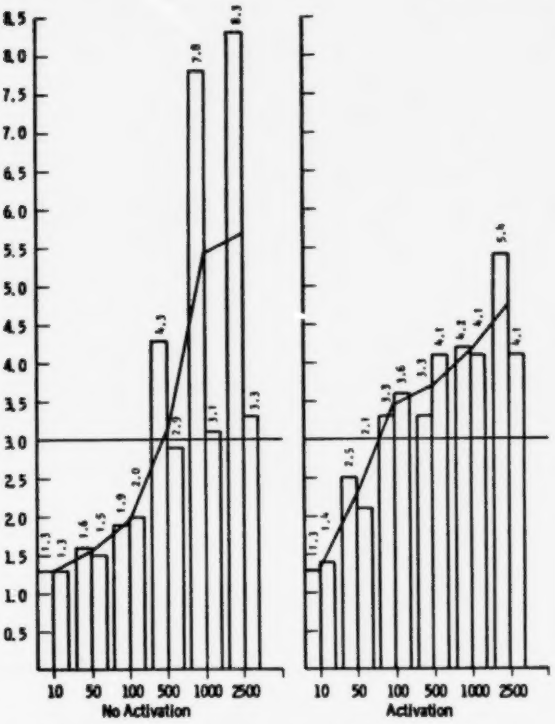


Fig. C157 – SRI AMES test data on residual oil fractions

Sample RO 16-3 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719335-A

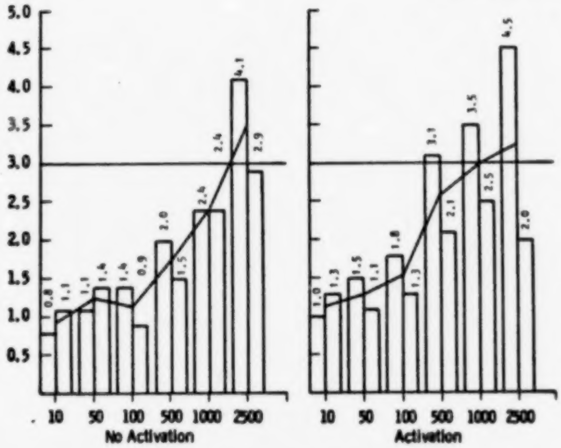


Fig. C158 – SRI AMES test data on residual oil fractions

Sample RO 16-4 Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719334-A

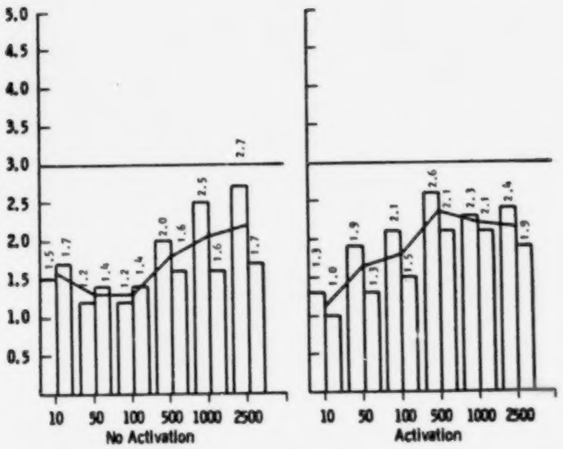


Fig. C159 – SRI AMES test data on residual oil fractions

Sample RO 16-5    Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

Curve 719337-A

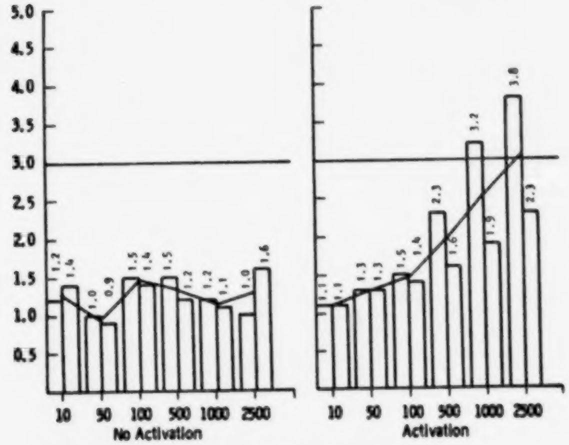


Fig. C160 – SRI AMES test data on residual oil fractions

Sample RO 16-6    Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

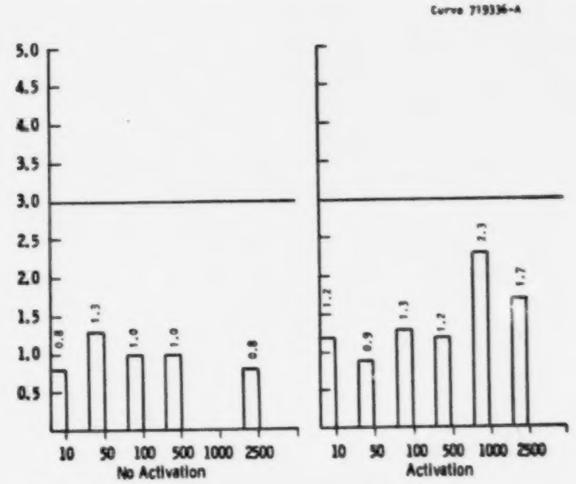


Fig. C161 – SRI AMES test data on residual oil fractions

Sample RO 16-7    Tester Strain TA 98

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

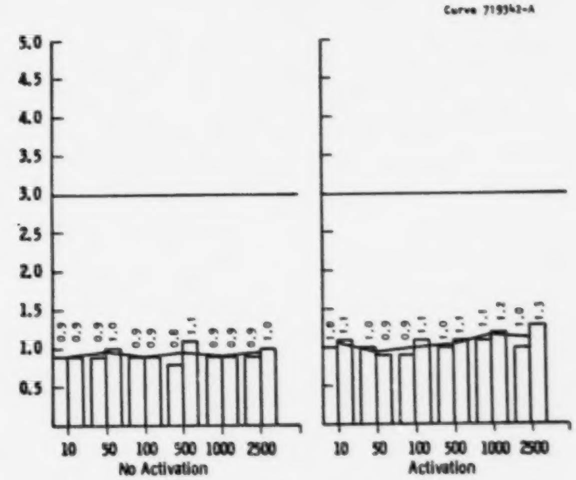


Fig. C162 – SRI AMES test data on residual oil fractions

Sample RO 16-1    Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

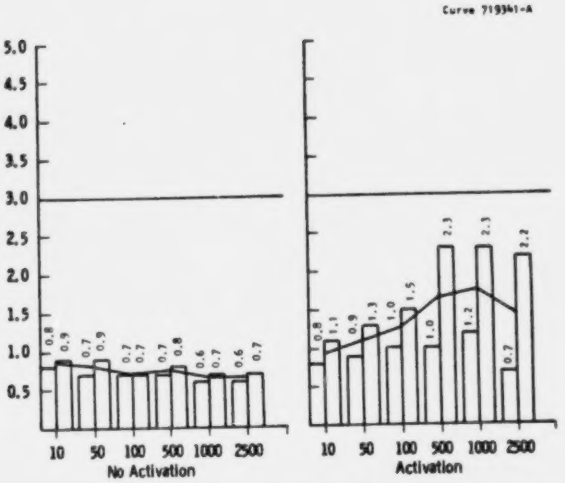


Fig. C163 – SRI AMES test data on residual oil fractions

Sample RO 16-2    Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

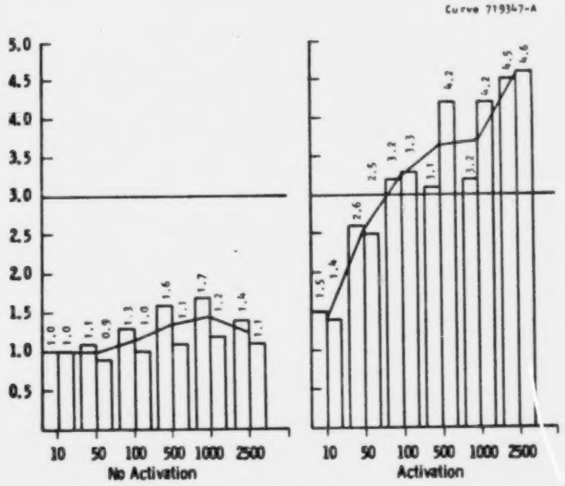


Fig. C164 – SRI AMES test data on residual oil fractions

Sample RO 16-3    Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

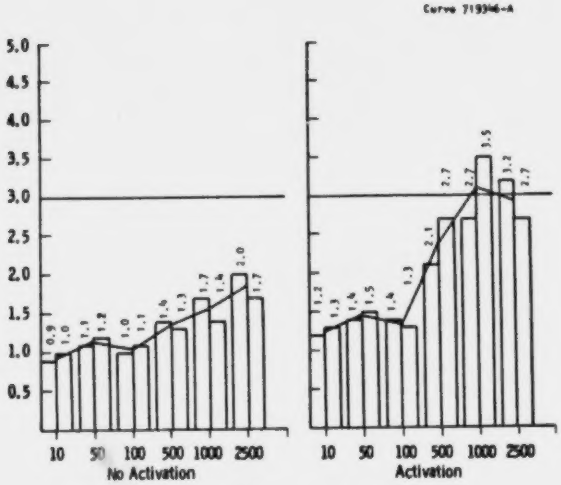


Fig. C165 — SRI AMES test data on residual oil fractions

Sample RO 16-4 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

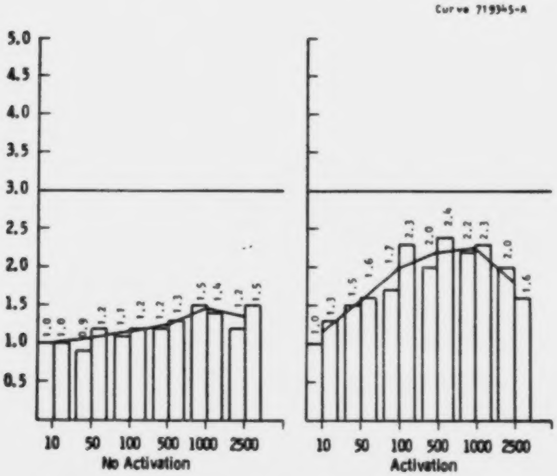


Fig. C166 — SRI AMES test data on residual oil fractions

Sample RO 16-5 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

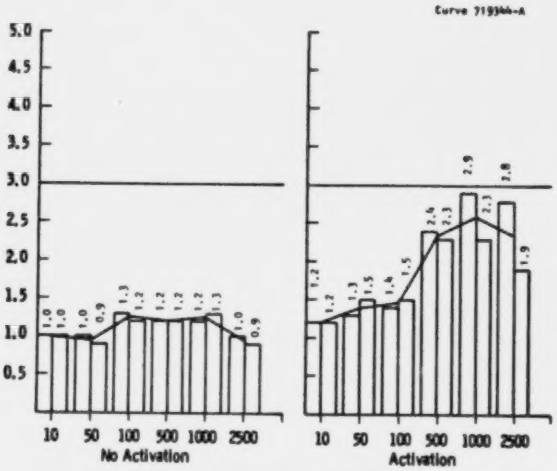


Fig. C167 – SRI AMES test data on residual oil fractions

Sample RO 16-6 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

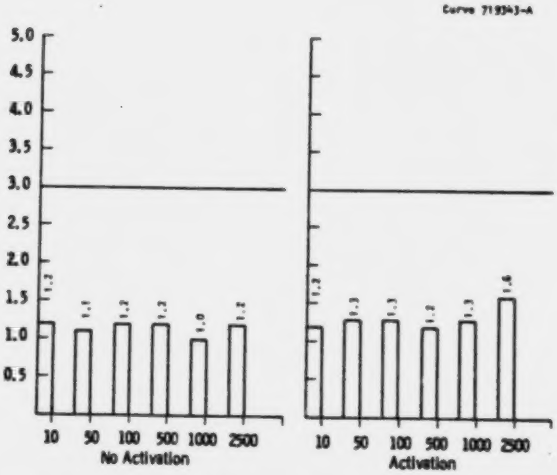


Fig. C168 – SRI AMES test data on residual oil fractions

Sample RO 16-7 Tester Strain TA 100

Each bar represents one test run by Stanford Research Institute. X-axis is test chemical per plate in micrograms. Y-axis is R ratio values (Test over control revertants). Activation means chemical exposed to rat liver microsome fraction (S9). No activation means no S9 exposure.

## APPENDIX D

## BIOASSY BY W OF 10 SUB-FRACTIONS OF FRACTION 3, OIL NO. 16, SOLUBLES AND INSOLUBLES OF OIL NO. 16

The fraction No. 3 of residual oil RO#16 was further resolved into ten subfractions. The sample concentration was 9 μg/ml p-dioxane (micrograms per microliter).

The DMSO partitioning of RO#16 is given in Figure 62, where the history of bioassayed fractions H, B, D, and G is given.

Three plates were used for each concentration. The small amount of sample of certain fractions necessitated a reduction for the concentrations tested. The p-dioxane, evidently due to aging oxidation, was toxic for the non-activation series. This did not affect the results, because tester strain control was available and the p-dioxane used for carrying the samples was not toxic, coming from a fresh supply used by the Analytical Chemistry group performing the sorbent partitioning.

## Table D1

## TEN FRACTIONS OF NO. 3 FRACTION OF RO#16
## (SAMPLE CONCENTRATION IS 9 MICROGRAMS PER MICROLITER DMSO)

| | | TA 1538 | | | | | | | | | | TA 98 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NO ACTIVATION | | | | | MICROSOME ACTIVATION | | | | | NO ACTIVATION | | | | | MICROSOME ACTIVATION | | | | |
| | | 1 | 2 | 3 | AVG. | R | 1 | 2 | 3 | AVG. | R | 1 | 2 | 3 | AVG. | R | 1 | 2 | 3 | AVG. | R |
| Tester Strain T.S. | | 14 | 21 | 18 | 18 | | 33 | 30 | 29 | 31 | | 15 | 14 | 19 | 16 | | 37 | 42 | 25 | 38 | |
| T.S. + DMSO | | 19 | 14 | 17 | 17 | | 19 | 19 | 17 | 18 | | 10 | 19 | 14 | 14 | | 31 | 41 | 27 | 33 | |
| T.S. + Positive Entr | | | | 1161 | | 64.5 | | | 1262 | | 70 | | | 1246 | | 78 | | | 1678 | | 44 |
| T.S. + p-Dioxan | | | Toxic | | | | 33 | 25 | 24 | 27 | | | Toxic | | | | 24 | 28 | 30 | 27 | |
| #1 | 10 | 13 | 22 | 10 | 15 | .9 | 37 | 36 | 27 | 33 | 1.2 | 13 | 11 | 9 | 11 | .8 | 53 | 75 | 50 | 59 | 2.2 |
| | 50 | | | | | | 111 | 98 | 93 | 101 | 3.7 | | | | | | 184 | 186 | 216 | 195 | 7.2 |
| | 100 | | | | | | 68 | 111 | 78 | 86 | 3.2 | | | | | | 136 | 140 | 141 | 139 | 5.1 |
| #2 | 10 | 11 | 15 | 8 | 11 | .7 | 34 | 40 | 38 | 37 | 1.4 | 17 | 12 | 13 | 16 | 1.1 | 55 | 52 | 41 | 49 | 1.8 |
| | 50 | | | | | | 72 | 80 | 90 | 81 | 3.0 | | | | | | 149 | 150 | 147 | 149 | 5.4 |
| | 100 | | | | | | 67 | 73 | 79 | 73 | 2.7 | | | | | | 87 | 125 | 84 | 99 | 3.6 |
| #3 | 10 | 16 | 14 | 15 | 15 | .9 | 33 | 54 | 34 | 40 | 1.5 | 16 | 10 | 14 | 13 | 1.0 | 57 | 56 | 43 | 52 | 1.9 |
| | 50 | | | | | | 104 | 85 | 121 | 103 | 3.8 | | | | | | 174 | 198 | 181 | 184 | 6.8 |
| | 100 | | | | | | 104 | 69 | 72 | 82 | 3.0 | | | | | | 183 | 173 | 165 | 174 | 6.4 |
| #4 | 10 | 10 | 12 | 8 | 10 | .6 | 43 | 34 | 51 | 43 | 1.6 | 7 | 11 | 10 | 19 | .7 | 86 | 105 | 70 | 87 | 3.2 |
| | 50 | | | | | | 109 | 110 | 116 | 112 | 4.1 | | | | | | 238 | 261 | 254 | 251 | 9.2 |
| | 100 | | | | | | 69 | 61 | 114 | 81 | 3.0 | | | | | | 168 | 181 | 207 | 185 | 6.8 |
| #5 | 10 | 17 | 18 | 14 | 16 | 1.0 | 36 | 35 | 37 | 36 | 1.3 | 10 | 12 | 12 | 11 | .8 | 52 | 59 | 122 | 71 | 2.6 |
| | 50 | | | | | | 110 | 101 | 104 | 105 | 3.9 | | | | | | 163 | 213 | 201 | 192 | 7.0 |
| | 100 | | | | | | 86 | 115 | 86 | 96 | 3.5 | | | | | | 156 | 172 | 125 | 151 | 5.5 |
| #6 | 10 | 18 | 19 | 23 | 20 | 1.2 | 36 | 39 | 34 | 36 | 1.3 | 11 | 13 | 13 | 12 | .9 | 62 | 65 | 74 | 67 | 2.5 |
| | 50 | | | | | | 133 | 122 | 120 | 125 | 4.6 | | | | | | 230 | 203 | 211 | 215 | 7.9 |
| | 100 | | | | | | 88 | 100 | 98 | 95 | 3.5 | | | | | | 162 | 186 | 181 | 176 | 6.5 |
| #7 | 10 | 13 | 13 | 9 | 12 | .7 | 42 | 51 | 55 | 49 | 1.8 | | | | | | | | | | |
| | 50 | | | | | | 77 | 96 | 70 | 81 | 3.0 | | | | | | | | | | |
| | 100 | | | | | | 55 | 59 | 48 | 54 | 2.0 | | | | | | | | | | |
| #8 | 10 | 20 | 13 | 11 | 15 | .9 | 41 | 32 | 42 | 38 | 1.4 | 9 | 12 | 18 | 13 | .9 | 66 | 61 | 126 | 84 | 3.1 |
| | 50 | | | | | | 122 | 118 | 91 | 110 | 4.1 | | | | | | 124 | 161 | 158 | 148 | 5.4 |
| | 100 | | | | | | 81 | 76 | 75 | 77 | 2.9 | | | | | | 161 | | | | 5.9 |
| #9 | 100 | | | | | | Drop 142 | | | | 5.3 | | | | | | | | | | |
| #10 | 100 | | | | | | 55 | 37 | 48 | 47 | 1.7 | | | | | | | | | | |

Table D2

DMSO PARTITIONING OF RO#16. LEGEND FOR FRACTION A, B, D, AND G IN FIGURE 6.2. (SAMPLE CONCENTRATION IS 9 MICROGRAMS PER MILILITER DMSO)

TA 1538

| | | NO ACTIVATION | | | | | MICROSOME ACTIVATION | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | AVG. | R | 1 | 2 | 3 | AVG. | R |
| Tester Strain T.S. | | 14 | 21 | 18 | 18 | | 33 | 30 | 29 | 31 | |
| T.S. + DMSO | | 19 | 14 | 17 | 17 | | 19 | 19 | 17 | 18 | |
| T.S. + Positive Entr | | | | 1161 | | 64.5 | | | 1262 | | 7.0 |
| T.S. + p-Dioxane | | | Toxic | | | | 33 | 25 | 24 | 27 | |
| | vol. in μℓ | | | | | | | | | | |
| Fract. A | 10 | 11 | 15 | 10 | 12 | .7 | 25 | 43 | 81 | 50 | 2.8 |
| DMSO | 50 | | | | | | 54 | 48 | 51 | 51 | 2.8 |
| | 100 | | | | | | 41 | 30 | 32 | 34 | 1.9 |
| Fract. B | 10 | 6 | 15 | 13 | 11 | .7 | 37 | 40 | 44 | 40 | 1.5 |
| DMSO | 50 | | | | | | 86 | 69 | 91 | 82 | 3.0 |
| | 100 | | | | | | 74 | 51 | 73 | 66 | 2.4 |
| Fract. D | 10 | 21 | 16 | 15 | 17 | 1.0 | 109 | 72 | 79 | 87 | 3.2 |
| DMSO | 50 | | | | | | 55 | 44 | 57 | 52 | 1.9 |
| | 100 | | | | | | 97 | 97 | 75 | 90 | 3.3 |
| Fract. G | 10 | 12 | 15 | 9 | 12 | .7 | 19 | 14 | 18 | 17 | .6 |
| DMSO | 50 | | | | | | 45 | 43 | 30 | 39 | 1.5 |
| | 100 | | | | | | 30 | 47 | 41 | 39 | 1.5 |

Table D2 (Cont)

TA 98

| | | NO ACTIVATION | | | | | MICROSOME ACTIVATION | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | AVG. | R | 1 | 2 | 3 | AVG. | R |
| Tester Strain T.S. | | 15 | 14 | 19 | 16 | | 37 | 42 | 35 | 38 | |
| T.S. + DMSO | | 10 | 19 | 14 | 14 | | 31 | 41 | 27 | 33 | |
| T.S. + Positive Entr | | | | 1246 | | 78 | | | 1678 | | 44 |
| T.S. + p-Dioxane | | | Toxic | | | | 24 | 28 | 30 | 27 | |
| | vol. in μℓ | | | | | | | | | | |
| Fract. A | 10 | 14 | 8 | 16 | 13 | .9 | 147 | 160 | 166 | 158 | 4.8 |
| DMSO | 50 | | | | | | 126 | 137 | 108 | 124 | 3.7 |
| | 100 | | | | | | 69 | 80 | 123 | 91 | 2.7 |
| Fract. B | 10 | 8 | 10 | 12 | 10 | .7 | 112 | 88 | 109 | 103 | 3.8 |
| DMSO | 50 | | | | | | 297 | 285 | 323 | 302 | 11.1 |
| | 100 | | | | | | 225 | 147 | 260 | 211 | 7.7 |
| Fract. D | 10 | 12 | 13 | 15 | 13 | 1.0 | 62 | 88 | 76 | 75 | 2.8 |
| DMSO | 50 | | | | | | 171 | 108 | 125 | 135 | 4.9 |
| | 100 | | | | | | 160 | 138 | 150 | 149 | 5.5 |
| Fract. G | 10 | 6 | 7 | 8 | 7 | .5 | 41 | 45 | 44 | 43 | 1.6 |
| DMSO | 50 | | | | | | 77 | 64 | 91 | 77 | 2.8 |
| | 100 | | | | | | 74 | 61 | 60 | 65 | 2.4 |

# APPENDIX E

## BIOASSY BY W OF COLUMN CHROMATOGRAPHY FRACTIONS OF DMSO SOLUBLES AND INSOLUBLES OF OIL NO. 16

## Table E1

## R016 AMES TEST RESULTS OF SEVEN DMSO INSOLUBLE FRACTIONS IN TA 1538 AND TA 98 PERFORMED BY W. R IS THE RATIO OF TEST OVER CONTROL REVERTANT COUNTS

### TA 1538

| | | NO ACTIVATION | | | | | MICROSOME ACTIVATION | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | AVG. | R | 1 | 2 | 3 | AVG. | R |
| Tester Strain (T.S.) | | 10 | 11 | 9 | 10 | | 21 | 24 | 10 | 18 | |
| T.S. + Solvent DMSO | | 9 | 8 | 9 | 9 | | | | | | |
| T.S. + DMSO + S9 | | | | | | | 34 | 28 | 26 | 29 | |
| T.S. + Positive Control | | | | 1024 | | 118.2 | | | 1502 | | 51.2 |
| | CONCN in µg | | | | | | | | | | |
| 1i | 100 | 10 | 18 | 3* | 14 | 1.6 | 29 | 24 | 28 | 27 | 0.9 |
| | 250 | 10 | 9 | 4* | 9.5 | 1.1 | 22 | 24 | 33 | 26 | 0.9 |
| | 500 | 9 | 11 | 13 | 11 | 1.3 | * | 26 | 16 | 21 | 0.7 |
| | 750 | 11 | 9 | 10 | 10 | 1.2 | 26 | 13 | 26 | 22 | 0.7 |
| | 1000 | 9 | 8 | 14 | 10 | 1.2 | 25 | 21 | 23 | 23 | 0.9 |
| 2i | 100 | 9 | 14 | 8 | 10 | 1.2 | 30 | 21 | 27 | 26 | 0.9 |
| | 250 | 14 | 8 | 9 | 10 | 1.2 | 28 | 33 | 31 | 31 | 1.0 |
| | 500 | 15 | 5 | 13 | 11 | 1.3 | 26 | 26 | 34 | 29 | 1.0 |
| | 750 | 13 | 11 | 10 | 11 | 1.3 | 30 | 33 | 34 | 32 | 1.1 |
| | 1000 | 11 | 15 | 22 | 16 | 1.8 | 30 | 53 | 29 | 37 | 1.3 |
| 3i | 100 | 8 | 8 | 20 | 12 | 1.3 | 26 | 30 | 41 | 32 | 1.1 |
| | 250 | 23 | 16 | 17 | 19 | 2.1 | 40 | 44 | 46 | 43 | 1.5 |
| | 500 | 23 | 19 | 19 | 20 | 2.2 | 63 | 62 | 53 | 59 | 2.0 |
| | 750 | 22 | 16 | 29 | 22 | 2.4 | 51 | 55 | 63 | 56 | 2.0 |
| | 1000 | 24 | 28 | 16 | 23 | 2.6 | 57 | 57 | 56 | 57 | 1.9 |
| 4i | 100 | 21 | 24 | 32 | 26 | 2.9 | 42 | 43 | 43 | 43 | 1.5 |
| | 250 | 21 | 20 | 19 | 20 | 2.2 | * | 53 | 46 | 50 | 1.7 |
| | 500 | 19 | 20 | 19 | 19 | 2.1 | 61 | 73 | 60 | 65 | 2.2 |
| | 750 | 24 | 15* | 11* | 17 | 1.9 | 64 | 68 | 62 | 65 | 2.2 |
| | 1000 | 13 | 13 | 16 | 14 | 1.6 | 66 | 63 | 66 | 65 | 2.2 |
| 5i | 250 | 7 | 5 | 11 | 8 | 0.9 | 43 | 46 | 34 | 41 | 1.4 |
| | 500 | 9 | 11 | | 10 | 1.2 | 47 | 44 | | 46 | 1.6 |
| | 750 | 10 | 9 | | 9.5 | 1.1 | 50 | 70 | | 60 | 2.0 |
| | 1000 | 13 | | | | 1.5 | 60 | | | | 2.0 |
| 6i | 250 | 12 | 11 | 13 | 12 | 1.4 | 35 | 32 | 38 | 35 | 1.2 |
| | 500 | 7 | 10 | * | 8.5 | 1.0 | 20 | 27 | 26 | 24 | 0.8 |
| | 750 | 16 | 10 | 12 | 13 | 1.5 | 27 | 23 | 36 | 29 | 1.0 |
| | 1000 | 13 | 9 | 11 | 11 | 1.3 | 35 | 26 | 40 | 34 | 1.1 |
| | | 9 | 17 | 14 | 13 | 1.5 | 34 | 36 | 37 | 36 | 1.2 |
| 7i | 250 | 8 | 14 | 11 | 11 | 1.3 | 27 | 24 | 30 | 27 | 0.9 |
| | 500 | 8 | 4* | 6 | 6 | 0.8 | 31 | 26 | 26 | 28 | 0.9 |
| | 750 | 8 | 14 | 7 | 10 | 1.1 | 30 | 28 | 31 | 30 | 1.0 |
| | 1000 | 9 | | | | 1.0 | 30 | | | | 1.0 |

## Table E1 (Cont)

### TA 98

| | | NO ACTIVATION | | | | | MICROSOME ACTIVATION | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | AVG. | R | 1 | 2 | 3 | AVG. | R |
| Tester Strain (T.S.) | | 19 | 21 | 17 | 13 | | 141 | 185 | | 161 | |
| T.S. + Solvent DMSO | | 12 | 18 | 11 | 14 | | | | | | |
| T.S. + DMSO + S9 | | | | | | | 189 | 235 | 166 | 196.7 | |
| T.S. + Positive Control | | | | 993 | | 72.6 | | | 1649 | | 8.4 |
| | CONCN in µg | | | | | | | | | | |
| 1i | 100 | 13 | 9 | 20 | 14 | 1.0 | 183 | 232 | 254 | 223 | 1.1 |
| | 250 | 17 | 15 | 17 | 17 | 1.2 | 245 | 238 | 235 | 239 | 1.2 |
| | 500 | 16 | 28 | 17 | 20 | 1.5 | 245 | * | 202 | 224 | 1.1 |
| | 750 | 16 | 17 | 18 | 17 | 1.2 | 182 | 175 | 199 | 185 | 0.9 |
| | 1000 | 15 | 17 | 20 | 17 | 1.3 | 168 | 181 | 218 | 189 | 1.0 |
| 2i | 100 | 15 | 16 | 15 | 15 | 1.1 | 149 | 171 | 249 | 190 | 1.0 |
| | 250 | 16 | 26 | 20 | 21 | 1.5 | 177 | 191 | 149 | 172 | 0.9 |
| | 500 | 20 | 13 | 17 | 17 | 1.2 | 186 | 193 | 204 | 194 | 1.0 |
| | 750 | 21 | 29 | 17 | 22 | 1.6 | 204 | 208 | 211 | 208 | 1.1 |
| | 1000 | 24 | 20 | 27 | 24 | 1.7 | 179 | 216 | 204 | 200 | 1.0 |
| 3i | 100 | 27 | 23 | 24 | 25 | 1.8 | 160 | 161 | 162 | 161 | 0.8 |
| | 250 | 20 | 26 | 25 | 24 | 1.7 | 200 | 180 | 179 | 186 | 0.9 |
| | 500 | 24 | 27 | 21 | 24 | 1.8 | 194 | 218 | 204 | 205 | 1.0 |
| | 750 | 35 | 31 | 26 | 31 | 2.2 | 231 | 258 | 229 | 239 | 1.2 |
| | 1000 | 30 | 31 | 25 | 29 | 2.1 | 211 | 216 | 211 | 213 | 1.1 |

## Table E2

## R016 AMES TEST RESULTS OF SEVEN DMSO SOLUBLE FRACTIONS IN TA 1538 AND TA 98 PERFORMED BY W. R IS THE RATIO OF TEST OVER CONTROL REVERTANT COUNTS

### TA 1538

| | | NO ACTIVATION | | | | | MICROSOME ACTIVATION | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | AVG. | R | 1 | 2 | 3 | AVG. | R |
| Tester Strain (T.S.) | | 3 | 11 | 12 | 9 | | 5 | 4 | 9 | 6 | |
| T.S. + Solvent DMSO | | 9 | 9 | 8 | 9 | | | | | | |
| T.S. + DMSO + S9 | | | | | | | 6 | 4 | 6 | 5 | |
| T.S. + Positive Control | | | | 716 | | 82.6 | | | 934 | | 175 |
| | CONCN in µg | | | | | | | | | | |
| 1s | 100 | 5 | 31 | 37 | 24 | 2.7 | 19 | 13 | 23 | 18 | 3.6 |
| | 250 | 19 | 20 | 24 | 21 | 2.3 | 13 | 15 | 12 | 13 | 2.7 |
| | 500 | 15 | 11 | 20 | 15 | 1.7 | 4 | 6 | 5 | 5 | 1.0 |
| | 750 | 18 | 19 | 18 | 18 | 2.0 | 6 | 4 | 7 | 6 | 1.1 |
| | 1000 | 19 | 24 | 12 | 18 | 2.0 | 2 | 3 | 10 | 5 | 1.0 |
| 2s | 100 | 17 | 16 | 8 | 14 | 1.5 | 16 | 18 | 14 | 16 | 3.2 |
| | 250 | 22 | 29 | 36 | 29 | 3.2 | 44 | 41 | 37 | 41 | 8.1 |
| | 500 | 68 | 73 | 65 | 69 | 7.6 | 76 | 75 | 81 | 77 | 15.5 |
| | 750 | 44 | 40 | 50 | 45 | 5.0 | 36 | 69 | 27 | 44 | 8.8 |
| | 1000 | 9 | 30 | 33 | 24 | 2.7 | 54 | 51 | 35 | 47 | 9.3 |
| 3s | 100 | 18 | 23 | 23 | 21 | 2.4 | 20 | 28 | 25 | 24 | 4.9 |
| | 250 | 41 | 50 | 40 | 44 | 4.9 | 59 | 47 | 70 | 59 | 11.7 |
| | 500 | 105 | 104 | 106 | 105 | 11.7 | 112 | 146 | 125 | 128 | 25.5 |
| | 750 | 103 | 89 | 93 | 95 | 10.6 | 113 | 111 | 111 | 112 | 22.3 |
| | 1000 | 55 | 84 | 75 | 71 | 7.9 | 115 | 49 | 45 | 70 | 13.9 |
| 4s | 100 | 13 | 20 | * | 16.5 | 1.8 | 30 | 28 | 20 | 26 | 5.2 |
| | 250 | 23 | 31 | 39 | 31 | 3.4 | 64 | 64 | 74 | 67 | 13.5 |
| | 500 | 48 | 46 | 53 | 49 | 5.4 | 54 | 54 | 59 | 56 | 11.1 |
| | 750 | 64 | 53 | 62 | 60 | 6.6 | 52 | 46 | 42 | 47 | 9.3 |
| | 1000 | 74 | 56 | 64 | 64.7 | 7.2 | * | 39 | 38 | 38.5 | 7.7 |
| 5s | 250 | 14 | 14 | | 14 | 1.6 | 22 | 22 | | 22 | 4.4 |
| | 500 | 14 | 24 | | 19 | 2.1 | 17 | 27 | | 22 | 4.4 |
| | 750 | 18 | 23 | | 20.5 | 2.3 | 16 | 19 | | 17.5 | 3.5 |
| 6s | 250 | 14 | 17 | | 15.5 | 1.7 | 30 | 30 | | 30 | 6.0 |
| | 500 | 17 | 20 | | 18.5 | 2.1 | 25 | 30 | | 27.5 | 5.5 |
| | 750 | 19 | 14 | | 16.5 | 1.8 | 33 | 25 | | 29 | 5.8 |
| 7s | 250 | 18 | 33 | | 25.5 | 2.8 | 53 | 58 | | 55.5 | 11.1 |
| | 500 | 24 | 23 | | 23.5 | 2.6 | 39 | 34 | | 36.5 | 7.3 |
| | 750 | 8 | 19 | | 13.5 | 1.5 | 20 | 20 | | 20 | 4.0 |

## Table E2 (Cont)

### TA 98

| | | NO ACTIVATION | | | | | MICROSOME ACTIVATION | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | AVG. | R | 1 | 2 | 3 | AVG. | R |
| Tester Strain (T.S.) | | 19 | 21 | 17 | 13 | | 8 | 11 | 8 | 9 | |
| T.S. + Solvent DMSO | | 12 | 18 | 11 | 14 | | | | | | |
| T.S. + DMSO + S9 | | | | | | | 13 | 8 | 12 | 12 | |
| T.S. + Positive Control | | | | 993 | | 72.6 | | | 818 | | 74.4 |
| | CONCN in µg | | | | | | | | | | |
| 1S | 100 | 84 | 39 | 70 | 64 | 4.6 | 51 | 42 | 40 | 44 | 3.7 |
| | 250 | 70 | 64 | 101 | 78 | 5.6 | 103 | 108 | 140 | 117 | 9.8 |
| | 500 | 86 | 111 | * | 98.5 | 7.0 | 69 | 67 | 87 | 74 | 6.2 |
| | 750 | 65 | 48 | 17 | 43 | 3.1 | 58 | 78 | 39 | 58 | 4.9 |
| | 1000 | 10 | 51 | 32 | 31 | 2.2 | 16 | 28 | 8 | 17 | 1.4 |
| 2S | 100 | 26 | 23 | 24 | 24 | 1.7 | 35 | 22 | 25 | 27 | 2.3 |
| | 250 | 52 | 43 | 38 | 44 | 3.2 | 45 | 63 | 86 | 65 | 5.4 |
| | 500 | 104 | 135 | 101 | 113 | 8.1 | 72 | 67 | 76 | 72 | 6.0 |
| | 750 | 104 | 103 | 104 | 104 | 7.4 | 62 | 62 | 49 | 58 | 4.8 |
| | 1000 | 21 | 60 | 41 | 41 | 2.9 | 44 | 47 | 49 | 47 | 3.9 |
| 3S | 100 | 25 | 28 | 34 | 29 | 2.1 | 17 | 30 | | | 2.0 |
| | 250 | 62 | 42 | 58 | 54 | 3.9 | 102 | 78 | 77 | 86 | 7.1 |
| | 500 | 122 | 106 | 150 | 126 | 9.0 | 112 | 124 | 116 | 117 | 9.8 |
| | 750 | 132 | 124 | 116 | 124 | 8.9 | 118 | 112 | 115 | 115 | 9.6 |
| | 1000 | 104 | 67 | 138 | 103 | 7.4 | 54 | 70 | 62 | 62 | 5.2 |

## Table E3

AMES TEST RESULTS WITH AND WITHOUT MICROSOME ACTIVATION OF SEVEN CHROMATOGRAPHIC FRACTIONS OF RO16 DMSO SOLUBLE PORTION IN MICROGRAMS PER PLATE RESULTS EXPRESSED AS R RATIO VALUES. (N.A. = NO ACTIVATION, S9 - S9MIX ADDED)

| | 100 μg | | 250 μg | | 500 μg | | 750 μg | | 1000 μg | |
|---|---|---|---|---|---|---|---|---|---|---|
| | .NA | .S9 | .NA | .S9 | .NA | .S9 | .NA | .S9 | .NA | .S9 |
| | | | | | TA 1538 | | | | | |
| 1s | 2.7 | 3.6 | 2.3 | 2.7 | 1.7 | 1.0 | 2.0 | 1.1 | 2.0 | 1.0 |
| 2s | 1.5 | 3.2 | 3.2 | 8.1 | 7.6 | 15.5 | 5.0 | 8.8 | 2.7 | 9.3 |
| 3s | 2.4 | 4.9 | 4.9 | 11.7 | 11.7 | 25.5 | 10.6 | 22.3 | 7.9 | 13.9 |
| 4s | 1.8 | 5.2 | 3.4 | 13.5 | 5.4 | 11.1 | 6.6 | 9.3 | 7.2 | 7.7 |
| 5s | | | 1.6 | 4.4 | 2.1 | 4.4 | 2.3 | 3.5 | | |
| 6s | | | 1.7 | 6.0 | 2.1 | 5.5 | 1.8 | 5.8 | | |
| 7s | | | 2.8 | 11.1 | 2.6 | 7.3 | 1.5 | 4.0 | | |
| | | | | | TA 98 | | | | | |
| 1s | 4.6 | 3.7 | 5.6 | 9.8 | 7.0 | 6.2 | 3.1 | 4.9 | 2.2 | 1.4 |
| 2s | 1.7 | 2.3 | 3.2 | 5.4 | 8.1 | 6.0 | 7.4 | 4.8 | 2.9 | 3.9 |
| 3s | 2.1 | 2.0 | 3.9 | 7.1 | 9.0 | 9.8 | 8.9 | 9.6 | 7.4 | 5.2 |

# APPENDIX F

## SELECTED GAS CHROMATOGRAMS OF RESIDUAL OIL FRACTIONS

Appendix F presents total ion gas chromatograms for all column preseparation fractions 2 thru 7 for 10 of the more interesting residual fuel oils examined under this contract. Comments on these chromatograms follow below.

### Residual Oil #1, Figure F-1

Fraction 2 of residual oil #1 shows an unusual number of GC peaks in terms of what is seen with the other 14 oils. Fraction 2 also appears to be essentially all volatile. It is possible that the degree of volatility can be presaged by the viscosity of the fraction. Fraction 2 from residual oil #1 is about the most fluid fraction 2 obtained with any oil.

Fraction 7 of residual oil #1 is showing a strong peak at a retention time of about 24 minutes. Computer library search fails to come up with any reasonable identification. As can be seen in Figure F-11, however, examination of the spectra identifies the material as dioctylphthalate which is confirmed from the literature. It also points out the reason for the failure of the library search since the molecular weight (390) was outside the range used in the data acquisition. (However, the strong m/e 149 peak in the mass spectra of Figure F-11 should have "suggested" a lower molecular weight phthalate to the computer). This material has been noted in many fraction 7's. A notable exception to this is oil #12. This compound could be artifact in the sodium sulfate used on the sample pre-fractionating column although infrared examination shows no such material on blanks of the column that correspond to fractions 1 through 7.

### Residual Oil #2, Figure 6

There is a pattern of peaks in Fractions 4, 5, 6 and 7 from residual oil #2 that suggests the presence of a homologous series and these peaks are indeed largely due to paraffinic hydrocarbons. This pattern is seen quite often with these oil fractions and the question arises as to why they are not restricted to fraction 1. In this regard occurrence of this material in these latter fractions is quite low. The "thickness" of the curve baseline is an indication of the signal amplification used to obtain 100% deflection in the y-axis in Figure F-2.

### Residual Oil #3, Figure F-3

Residual Oil #3 is characterized by the low level of volatility of its fractions, and the general absence of baseline "bulges". Analysis of this type of sample by GC/MS will be very borderline in effectiveness. Once again the baseline forcing is to be noted in Figure F-3.

### Residual Oil #4, Figure F-4

Fraction 2 from residual oil #4 is showing relatively little of the light ends of other oils that pass before retention time of about 25 minutes. There is an unusual, dominant peak at retention time of about 27 minutes. The area of the peak amounts to 41% of the total area of the peaks computed as above baseline in fraction 2. In terms of ion counts, it is suggested that the substance may be present at a 0.1% level in the fraction or about 0.01% in the as-received sample. There will be more about this peak in discussing residual oil #12, below.

### Residual Oil #7, Figure F-5

The "retention times" for the unresolved "bulges" in the different fractions of residual oil #7 are showing a great deal of variation. This is good evidence that, even though unresolved by the GC, these materials are probably separated into different species by the original column chromatography and suggest the possibility for future analysis with any successful LC/MS instrumentation.

The strong peak at a retention time of about 22.5 minutes and the peak triplet at about 24 minutes in fraction 7 are interesting. The strong peak contains 86% of the total peak areas found by computer. Based on ion counts, its level in the as-received sample is suggested to be 30 ppm. The mass spectra of this peak are shown in Figure F-12 (top). The data show a remarkable resemblance to the data of the peak from oil 1, fraction 7 (Figure F-11) in that major peaks of this material are 20 mass units less. This suggests a dioctylester of a dibasic acid, with MW 370 and having an acid of MW 146. This corresponds to dioctyladipate and as seen in Figure F-12 (bottom) this interpretation is correct.

The triplet peaks in fraction 7 are all due to dioctylphthalate. The computer peak search sees them as only one peak and it is not known why they emerged as three peaks on the chromatogram. (Mass spectra of all "three" peaks of the GC trace were individually scanned to show their similarity.)

Residual Oil #8, Figure F-6

Residual oil #8, all fractions, shows a sparsity of peaks other than those due to aliphatics. Unlike oil #3, there are strong "bulges" of unresolved material. The mass spectra of a bulge (as in fraction 8-2) are shown in Figure F-13. Major peaks at m/e 91, 105, 119 and 133 show the aromatic nature of the unresolved material, while there are also peaks suggesting aliphatic material or side chains. Figure F-13 illustrates the complexity of the material that is not being resolved.

Residual Oil #11, Figure F-7

The absence of baseline "bulges" in the first three fractions of residual oil #11 is unusual as is the shift in the position of the bulges in fractions 11-6 and 11-7 which were still on-going at the termination of the test. Of interest also are the three prominent peaks between retention times of 22 to 30 minutes in fraction 4. The major peak will be discussed further in the discussion of residual oil #12, below.

### Residual Oil #12, Figure F-8

There is a "finger-print" type of similarity between fractions 12-2 and 11-2 (from residual oil 11). With this clue, similar relationships can be seen in quite a few oils except that these latter oils have additional material. This relation only exists between fraction 2 of oils 11 and 12 and does not extend to the other five fractions of these 2 oils.

Fraction 12-5, however, does appear to have a finger-print relationship to 11-4 and this indicates that unknown factors can affect the polarity of material extracted with a given solvent system. Furthermore, the most intense peak in the chromatograms of 12-5 has the same material seen in fraction 2, residual oil #4 (see above). The mass spectra and its library-search identification is shown in Figure F-14. It does indeed look like the material in this peak (and in similar peaks in 4-2 and 11-4) is 4,8,12-trimethyl-3,7,11-tridecatrienenitrile.

The strong peaks in the chromatogram of 12-7 fraction are indeed due to paraffinic hydrocarbons. It is not known why this material was not extracted in an earlier fraction.

### Residual Oil #14, Figure F-9

Fraction 4 from residual oil #14 has an unusual, strong GC peak at a retention time of about 26.5 minutes. This material has a resemblance to that in the peak found with fraction 7-7 in that important mass spectral peaks now differ from those of dioctyladipate by a mass of 56 units greater. This suggests a dioctylester of a dibasic acid of molecular weight 426, having an acid of molecular weight 202, and probably being a homologue of adipic acid with 4 more methylene groups. There is no literature reference available of the mass spectra of such an ester. However, a library match produces bis(2-ethylhexyl)decanedioate. As can be seen in Figure F-15, the reference spectra differs in low amplitude but important mass spectral peaks at higher masses. Perhaps the configuration of "octyl" in the octyladipate is not as 2-ethylhexyl. At any rate, decanedioic acid has a molecular weight of 202 and the correlations with the spectra of octyladipate are such that the unknown is a dioctyldecanedioate and the ester portion is probably the same as the "octyl" in the unknown and reference of Figure 16 whether the reference is for n-octyl, isooctyl or any other "-octyl" adipate.

Residual Oil #15, Figure F-10

Fraction 4 from residual oil #15 is showing a strong peak at retention time about 11.5 minutes. Mass spectra of the peak (Figure F-16) shows an apparent molecular weight of 220 with loss of a methyl. The pattern 220, 205 is common in analyzing these oils. However, the retention time for the material is rather low. The library search identifies the material as 2,6-bis(1,1-dimethylethyl)-4-methylphenol and based on comparison of spectra in Figure F-16, the identification appears valid. This material is indicated (by retention time) in fraction #4 from other oils but apparently at reduced occurrence. This material is also used as an oil anti-oxidant and may suggest that reclaimed or processed, unused oil has been dumped into the fuel oil. This points up the complexities a "residual" sample can have in addition to those created solely by the oil refining process.

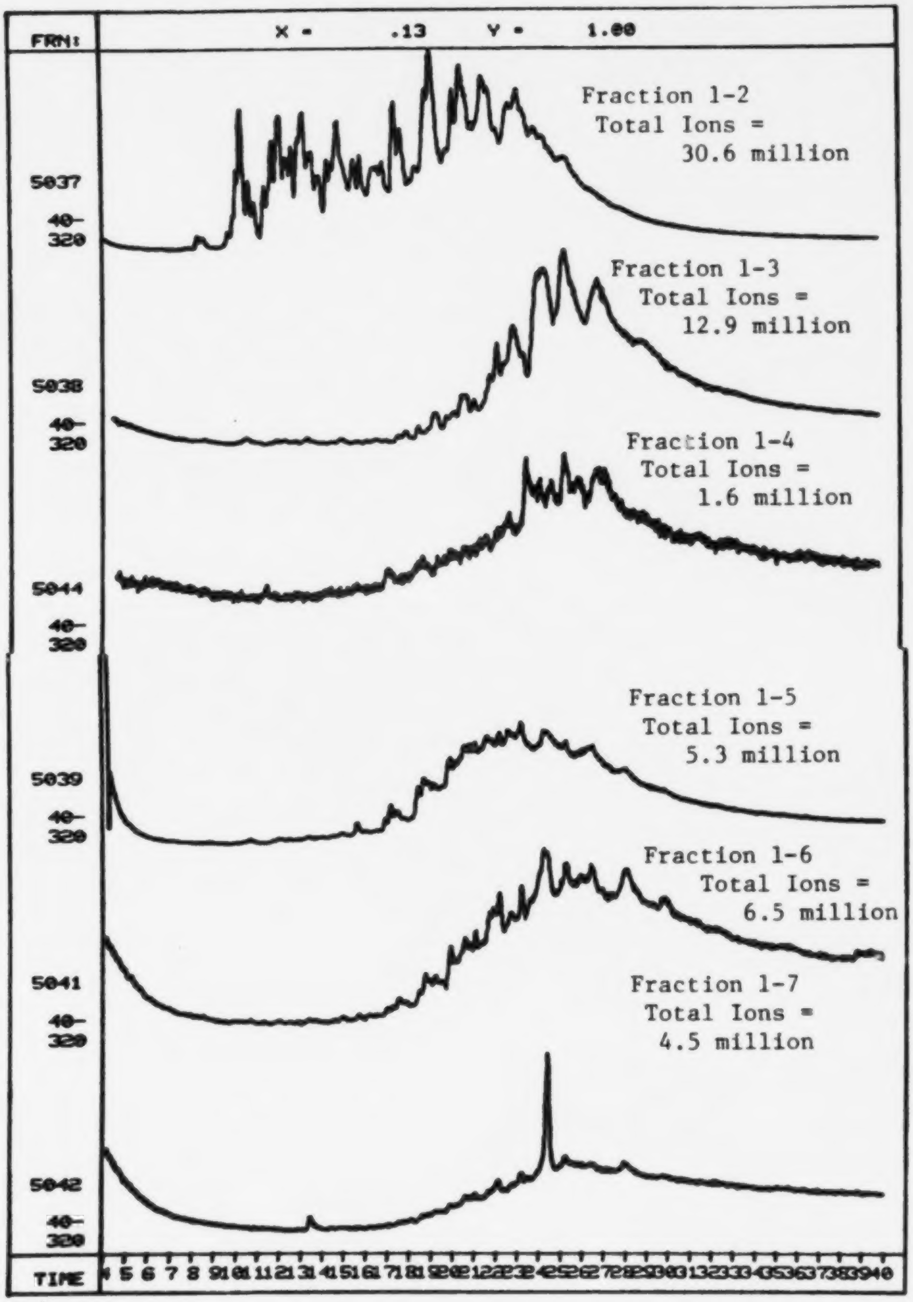


Figure F-1. Total Ion Chromatograms of Fractions From Oil #1

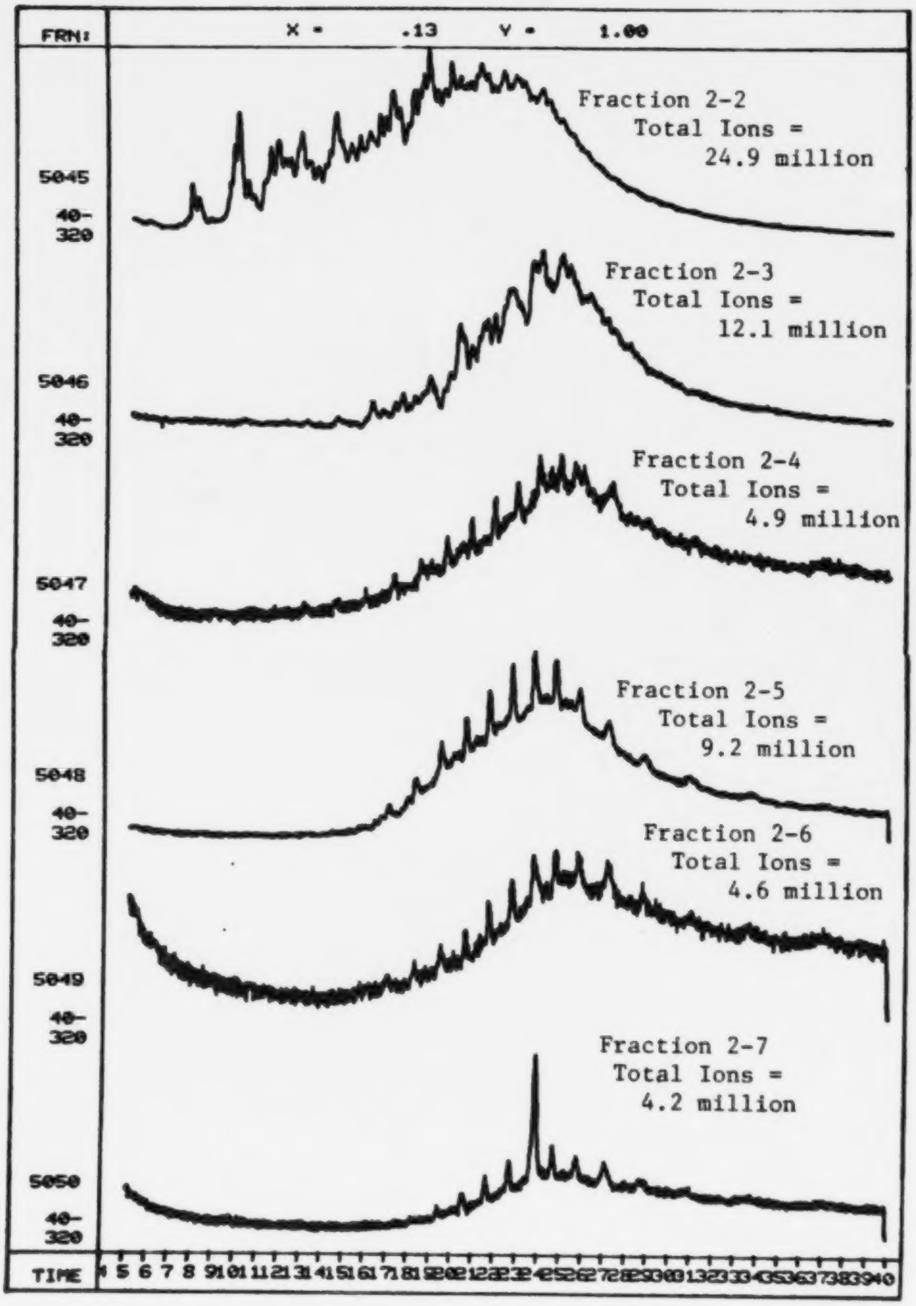


Figure F-2. Total Ion Chromatograms of Fractions From Oil #2

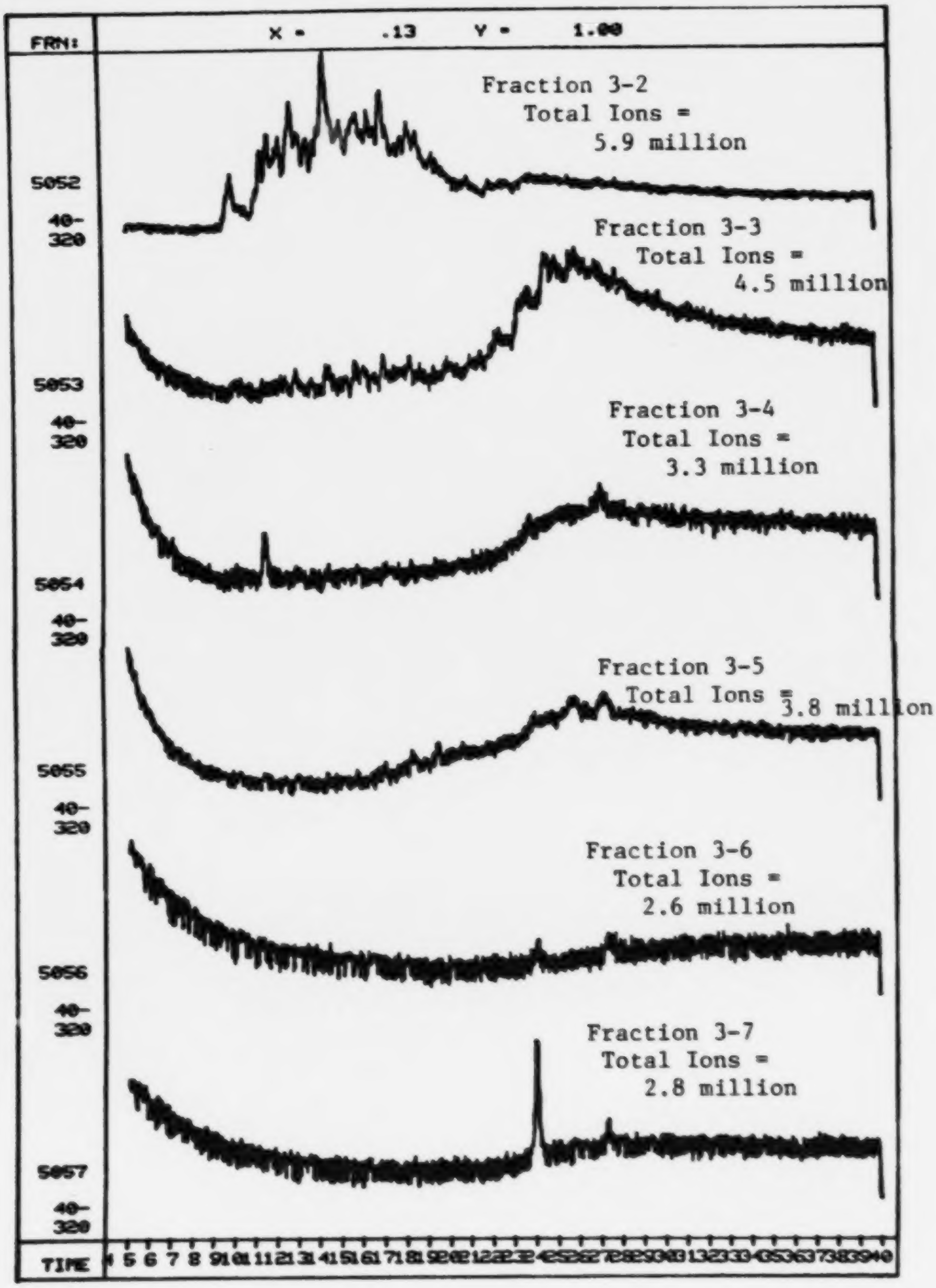


Figure F-3. Total Ion Chromatograms of Fractions From Oil #3

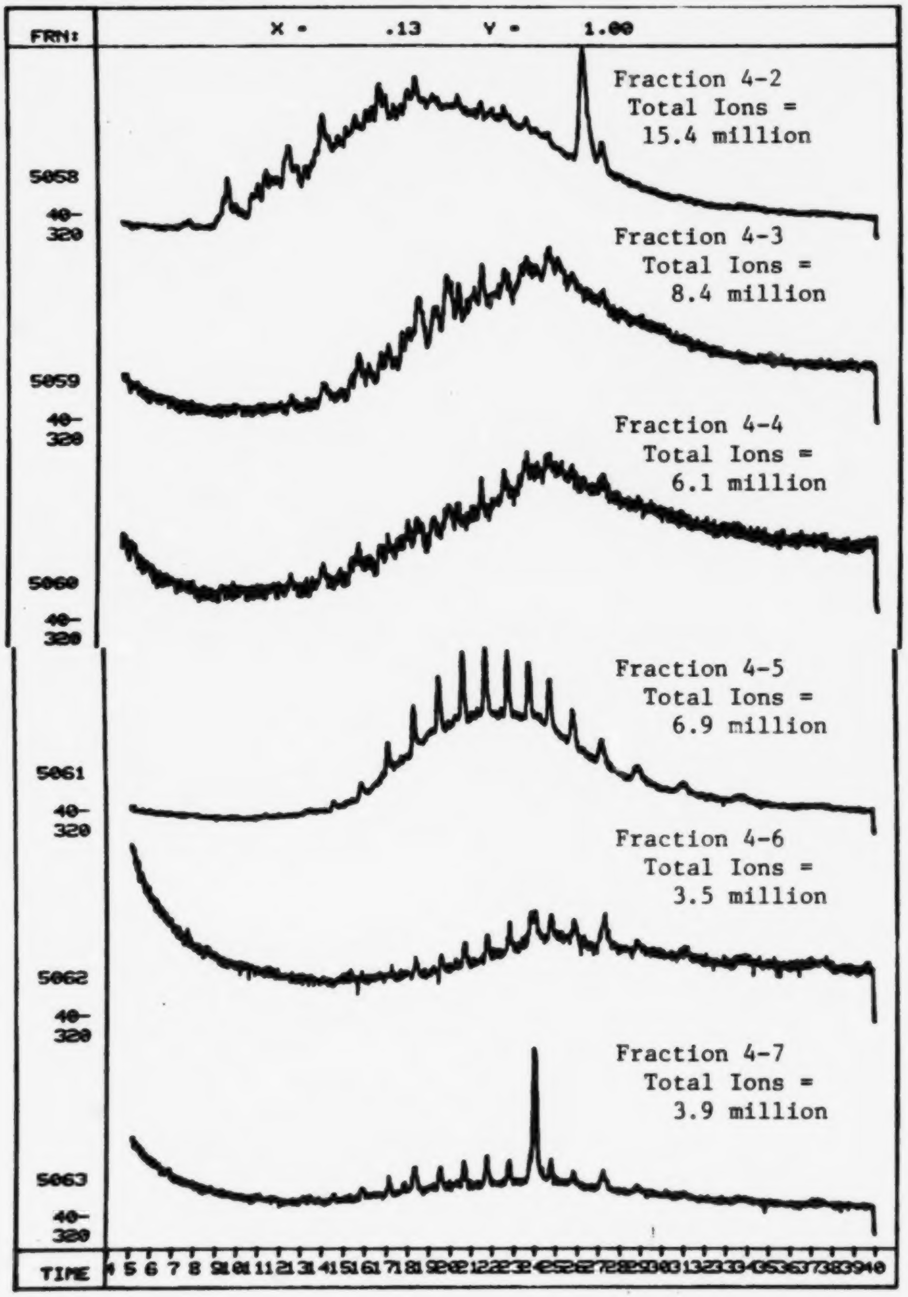


Figure F-4. Total Ion Chromatograms of Fractions From Oil #4

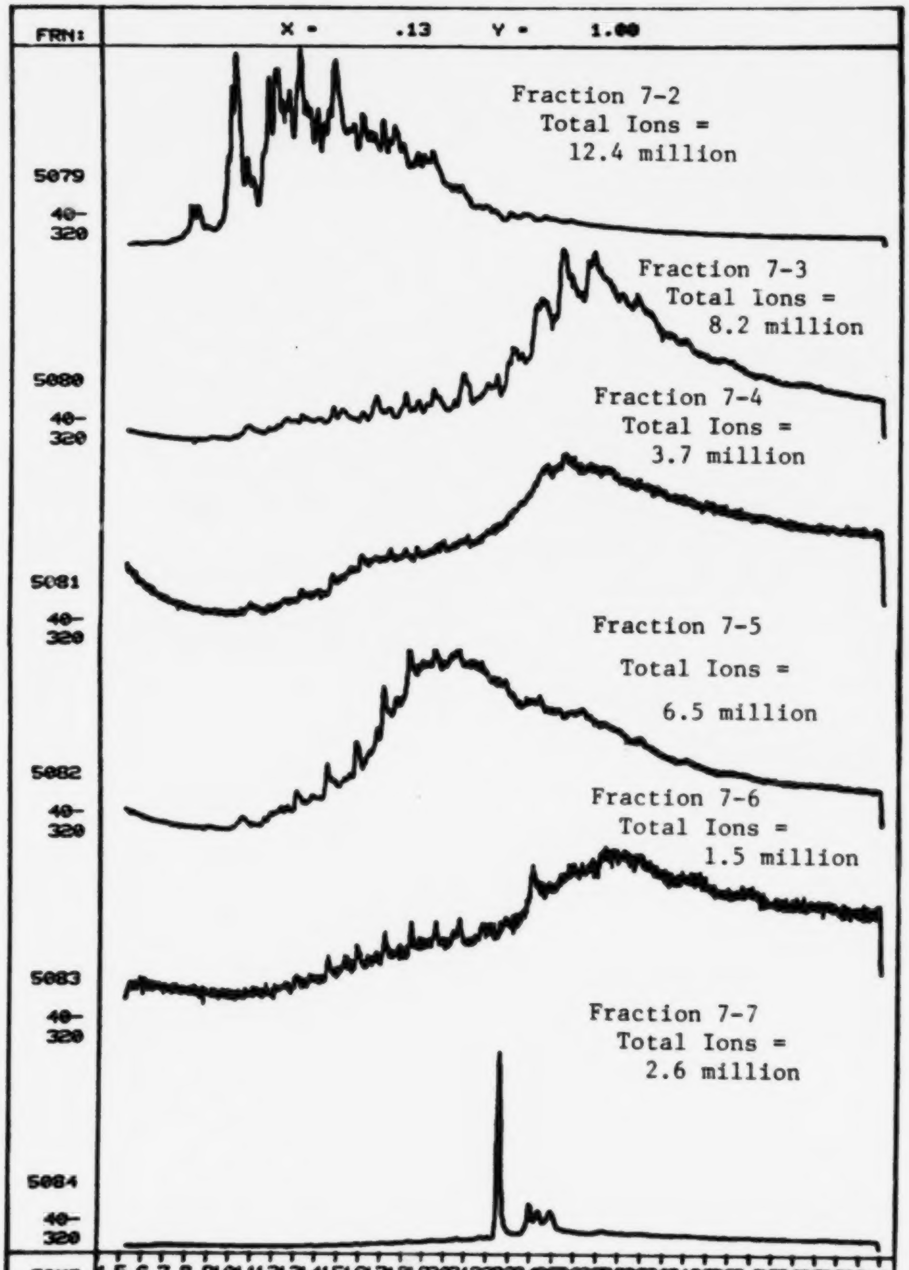


Figure F-5. Total Ion Chromatograms of Fractions From Oil #7

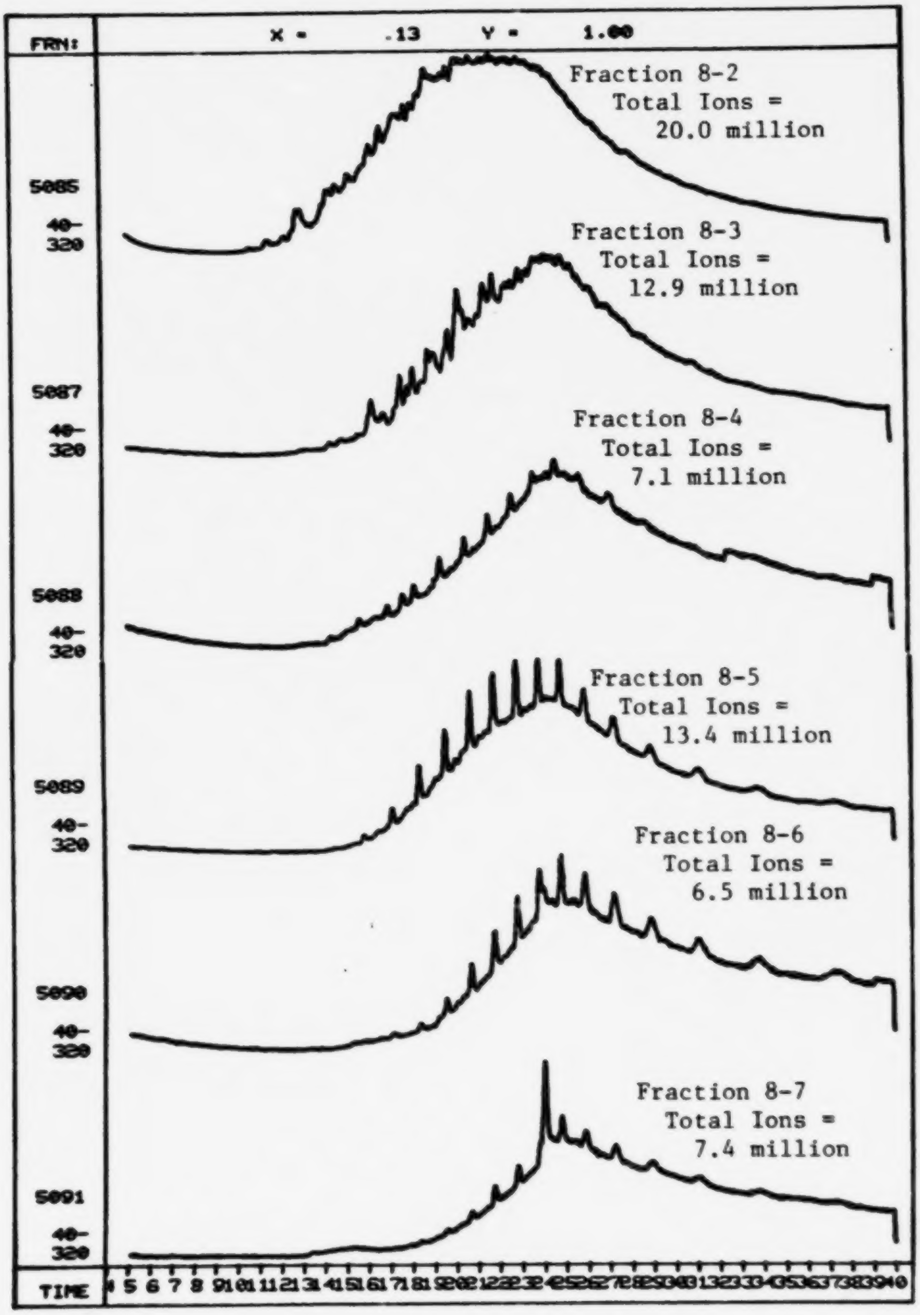


Figure F-6. Total Ion Chromatograms of Fractions From Oil #8

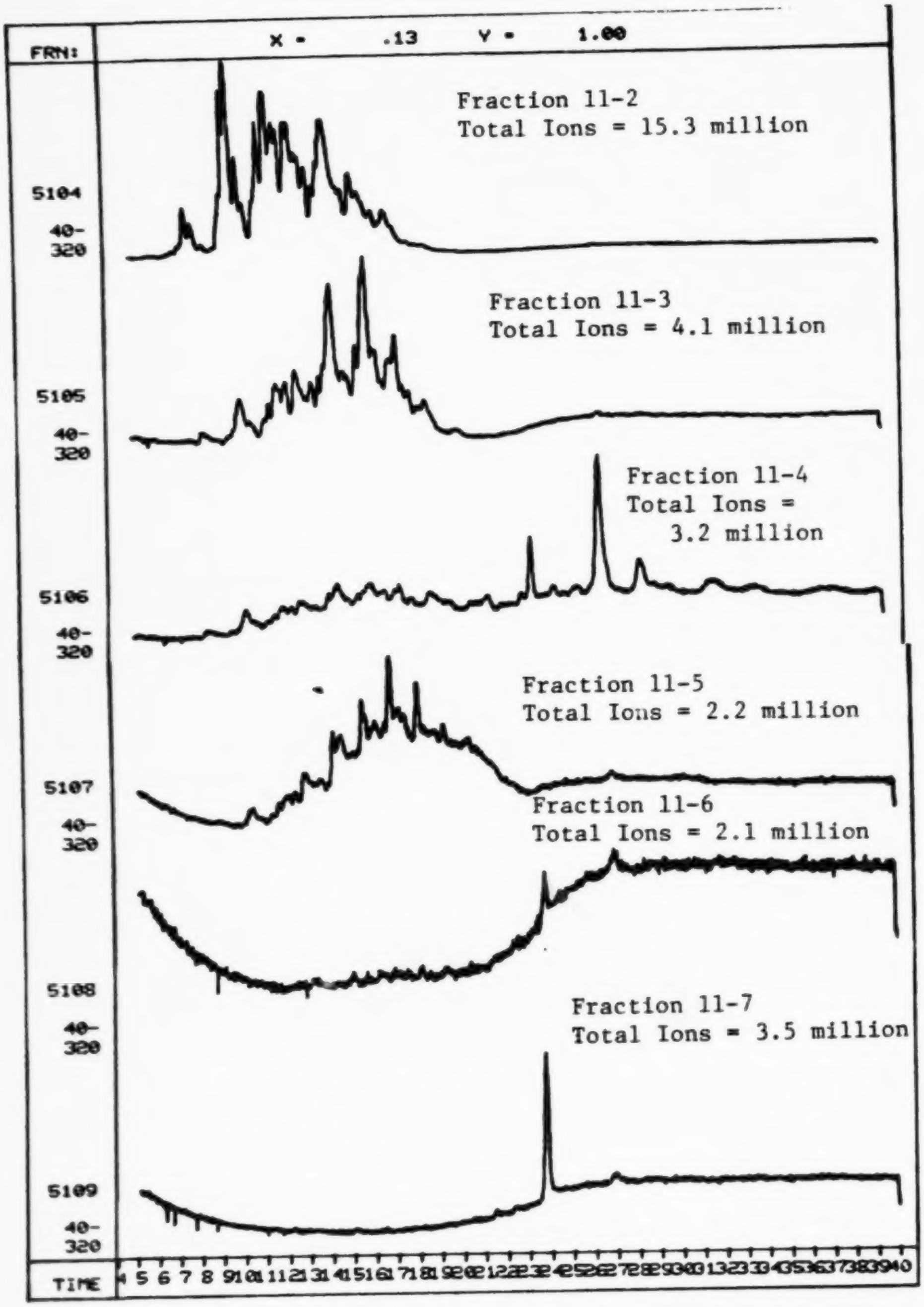


Figure F-7. Total Ion Chromatograms of Fractions From Oil #11

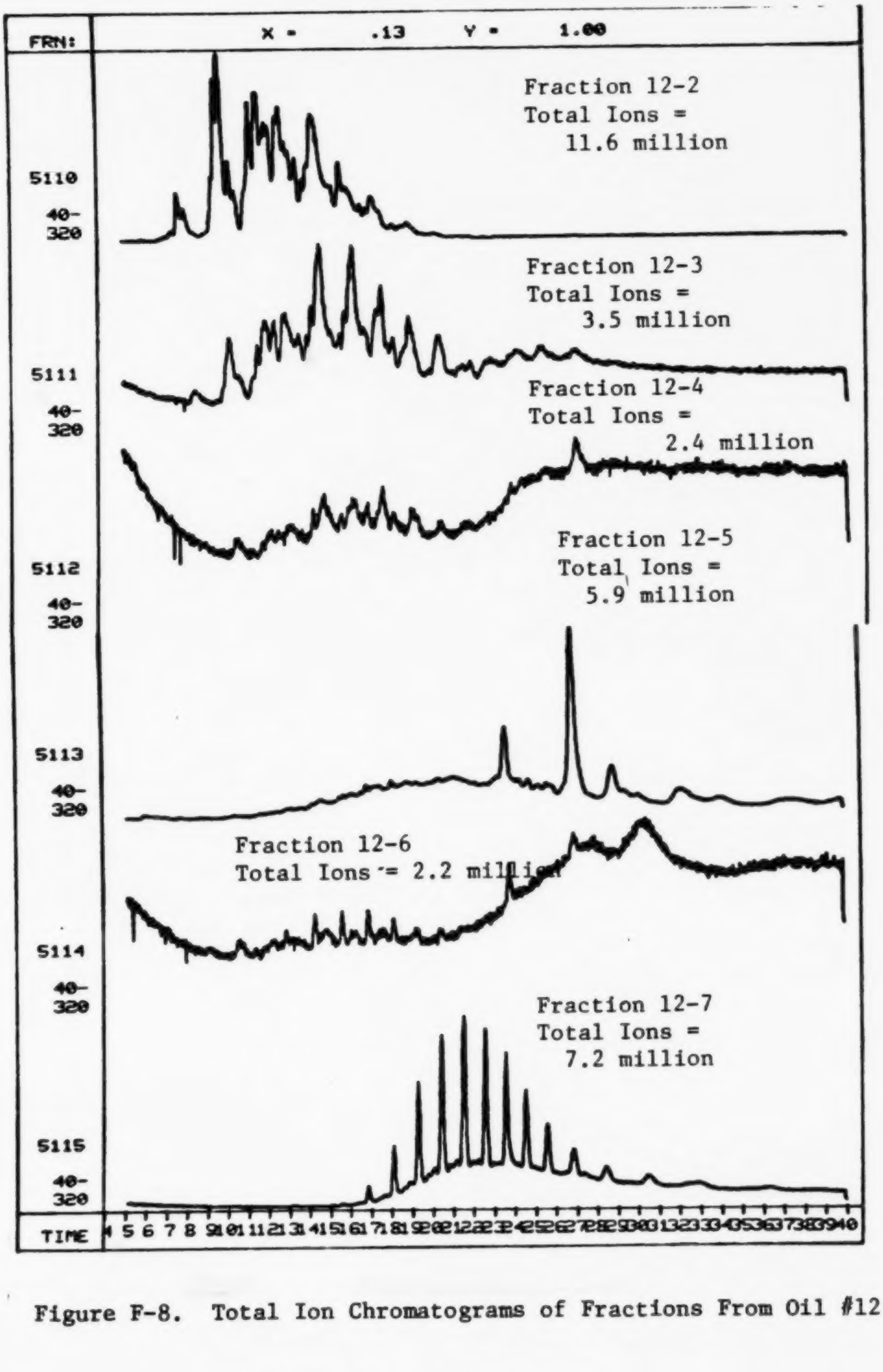


Figure F-8. Total Ion Chromatograms of Fractions From Oil #12

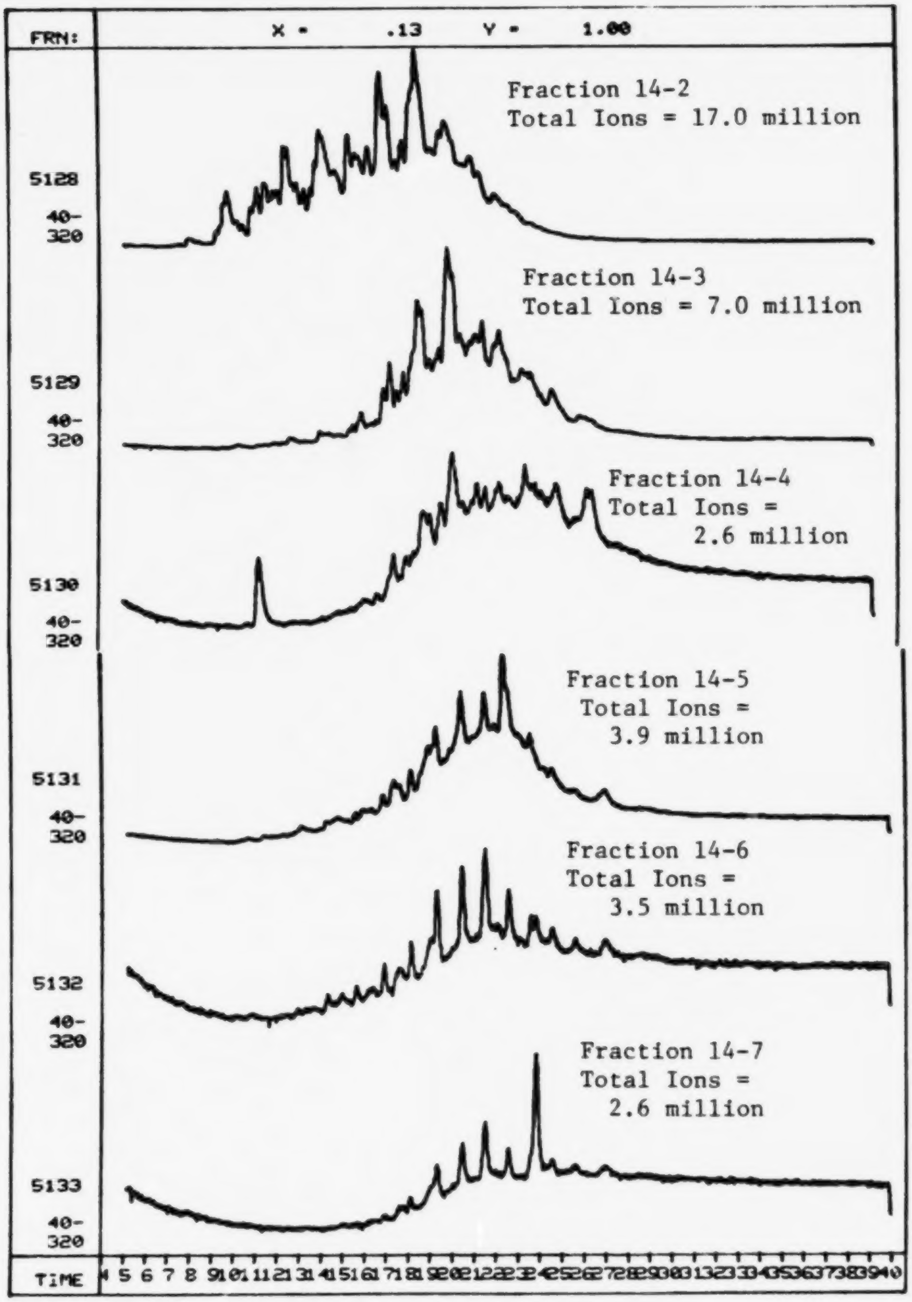


Figure F-9. Total Ion Chromatogram of Fractions From Oil #14

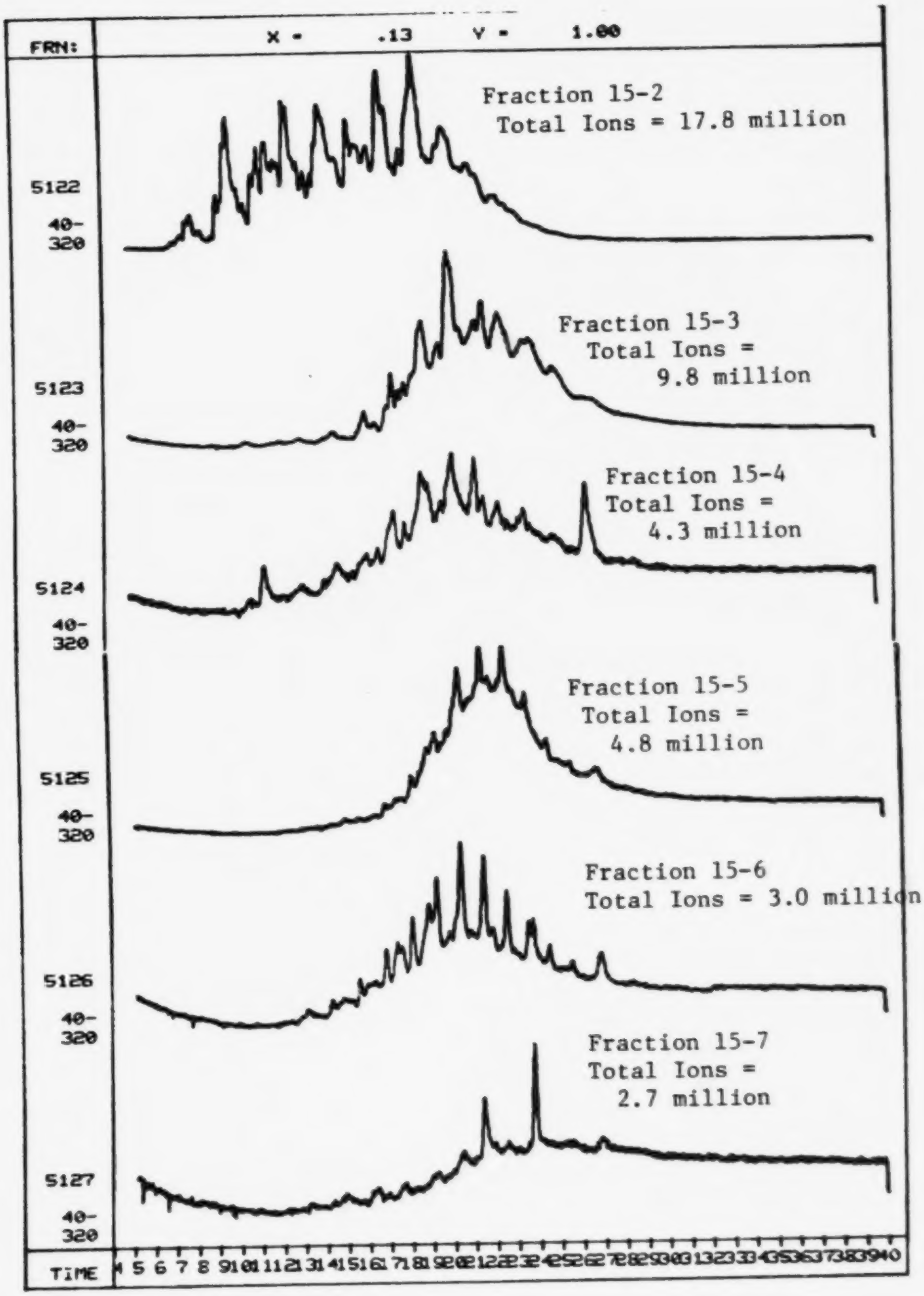
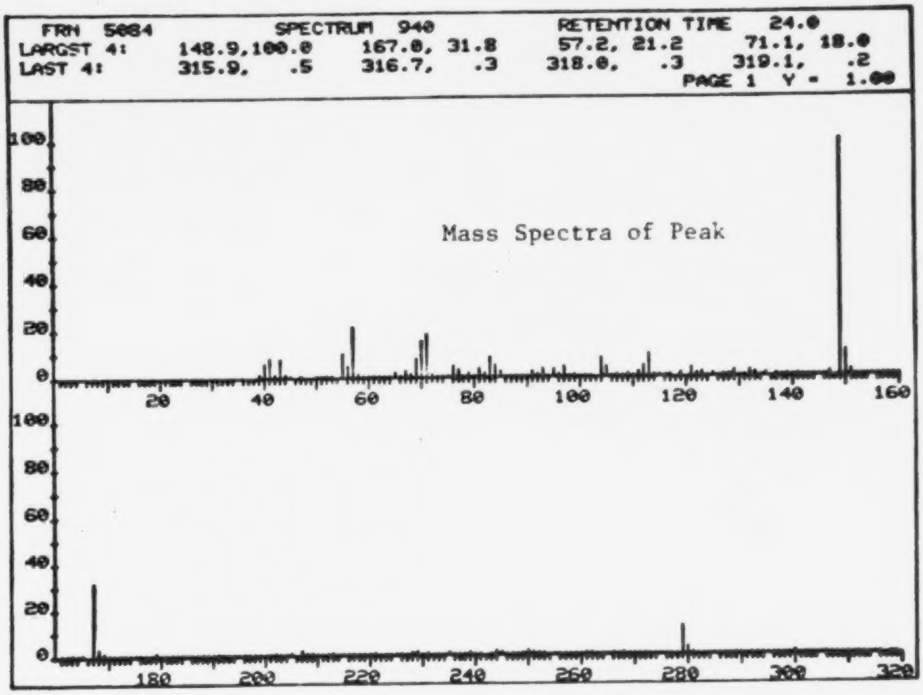
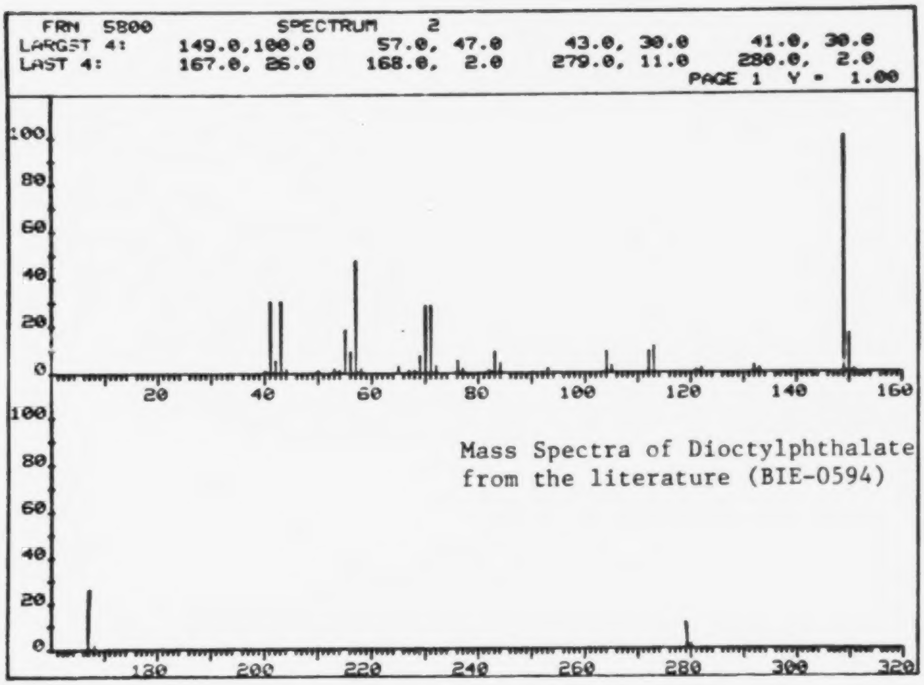


Figure F-10. Total Ion Chromatogram of Fractions From Oil #15

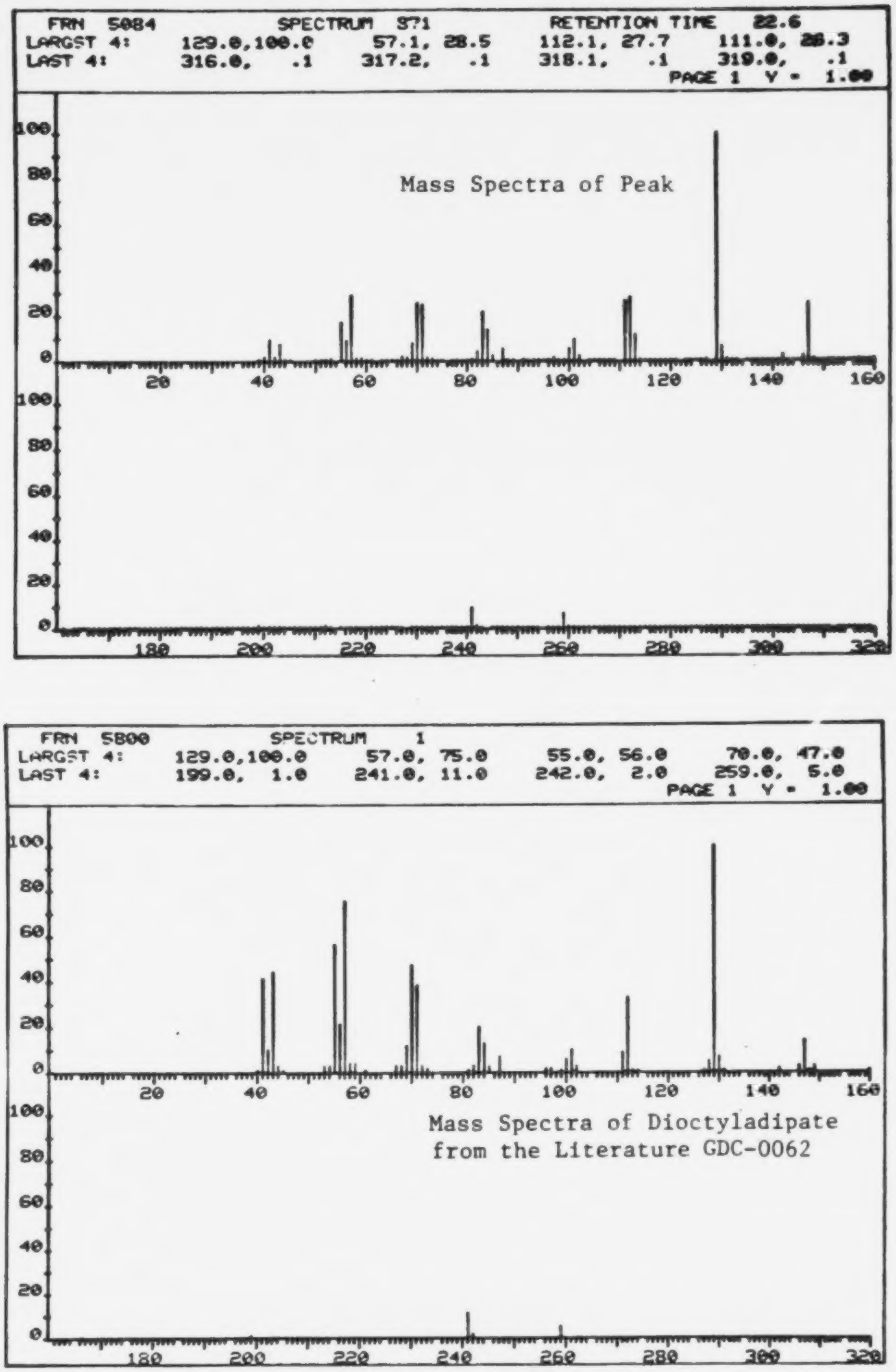


```
  FRN  5084            SPECTRUM  940            RETENTION TIME   24.0
LARGST 4:     148.9,100.0    167.0, 31.8    57.2, 21.2      71.1, 18.0
LAST 4:       315.9,    .5   316.7,    .3   318.0,    .3   319.1,    .2
                                                       PAGE 1  Y -  1.00
```



```
  FRN  5800            SPECTRUM    2
LARGST 4:     149.0,100.0     57.0, 47.0     43.0, 30.0      41.0, 30.0
LAST 4:       167.0, 26.0    168.0,  2.0    279.0, 11.0     280.0,  2.0
                                                       PAGE 1  Y -  1.00
```

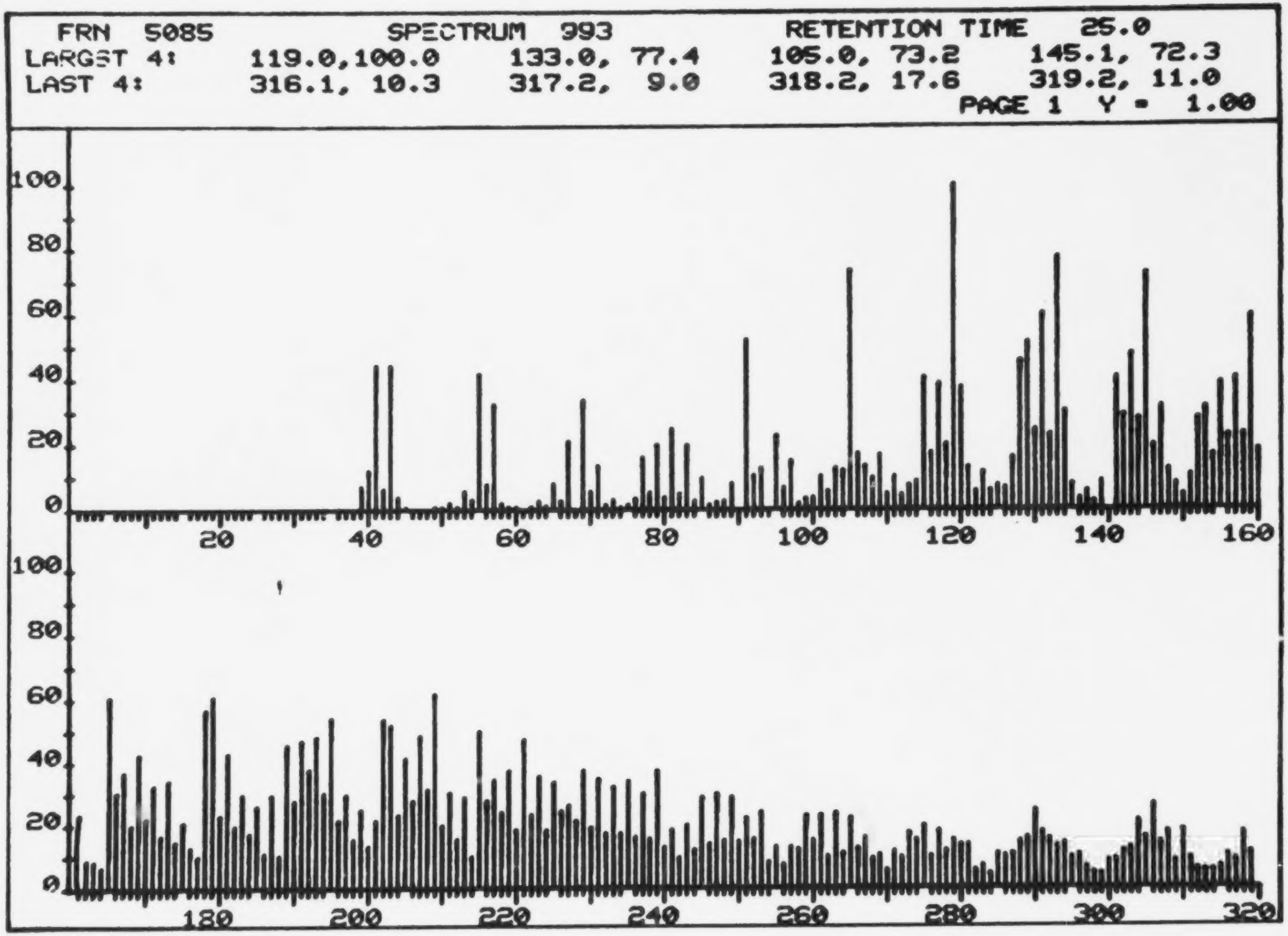
Figure F-11. Mass Spectra of a Consistent GC Peak at RT ~24 Minutes in Fraction 7 of a Residual Oil



```
  FRN  5084            SPECTRUM  371            RETENTION TIME   22.6
LARGST 4:     129.0,100.0     57.1, 28.5     112.1, 27.7     111.0, 28.3
LAST 4:       316.0,    .1   317.2,    .1    318.1,    .1    319.0,    .1
                                                          PAGE 1  Y =  1.00
```

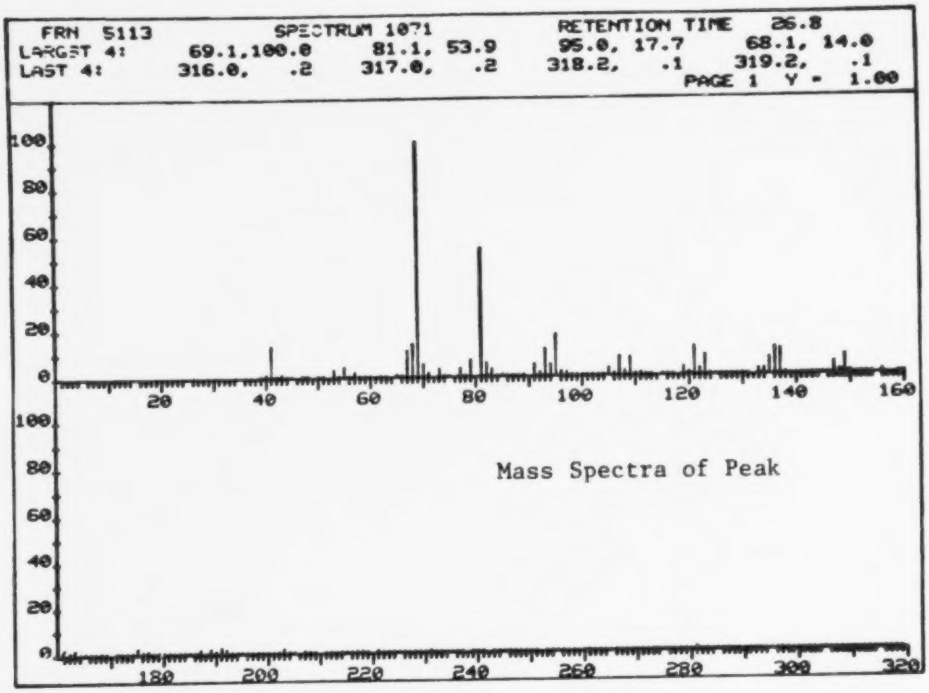
```
  FRN  5800            SPECTRUM    1
LARGST 4:     129.0,100.0     57.0, 75.0     55.0, 56.0     70.0, 47.0
LAST 4:       199.0,  1.0    241.0, 11.0    242.0,  2.0    259.0,  5.0
                                                         PAGE 1  Y =  1.00
```

Figure F-12. Mass Spectra of GC Peak @ RT ∿22.5 Minutes in Fraction 7-7

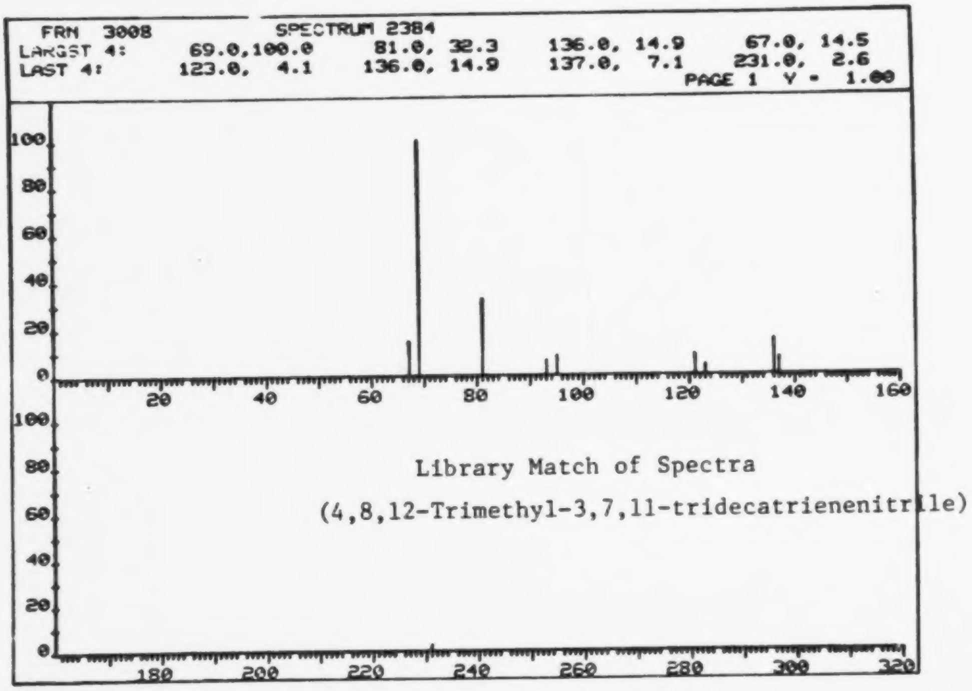


```
  FRN  5085            SPECTRUM  993          RETENTION TIME   25.0
LARGST 4:    119.0,100.0     133.0, 77.4    105.0, 73.2     145.1, 72.3
LAST 4:      316.1, 10.3     317.2,  9.0    318.2, 17.6     319.2, 11.0
                                                       PAGE 1  Y =  1.00
```

Figure F-13. Mass Spectra of Background "Bulge" in Total Ion Trace of Fraction 8-2

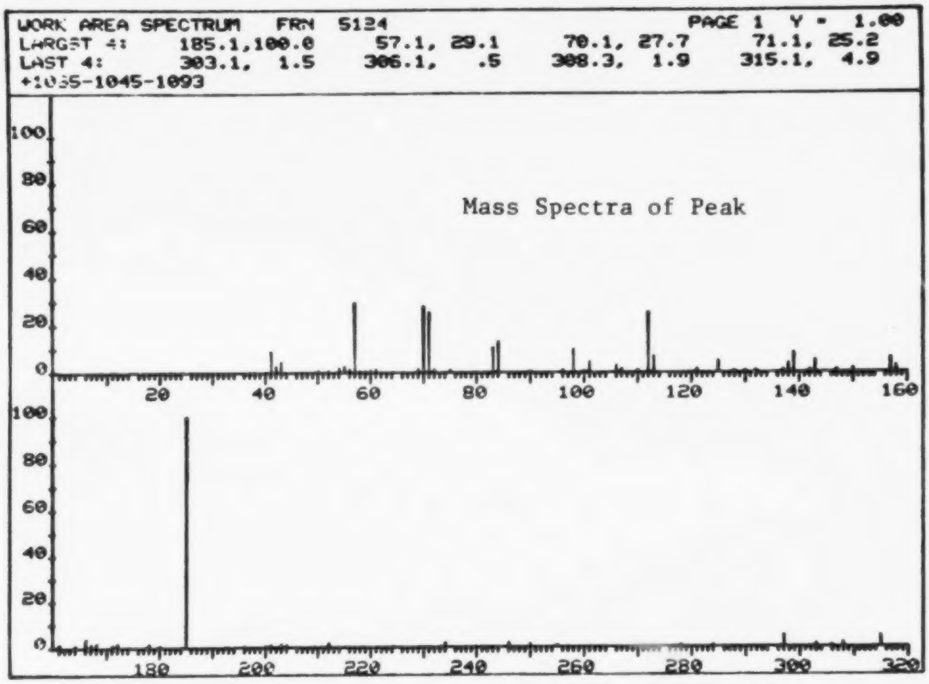


```
FRN  5113          SPECTRUM 1071           RETENTION TIME   26.8
LARGST 4:      69.1,100.0      81.1, 53.9     95.0, 17.7      68.1, 14.0
LAST 4:       316.0,    .2    317.0,    .2   318.2,    .1    319.2,    .1
                                                    PAGE 1  Y = 1.00
```



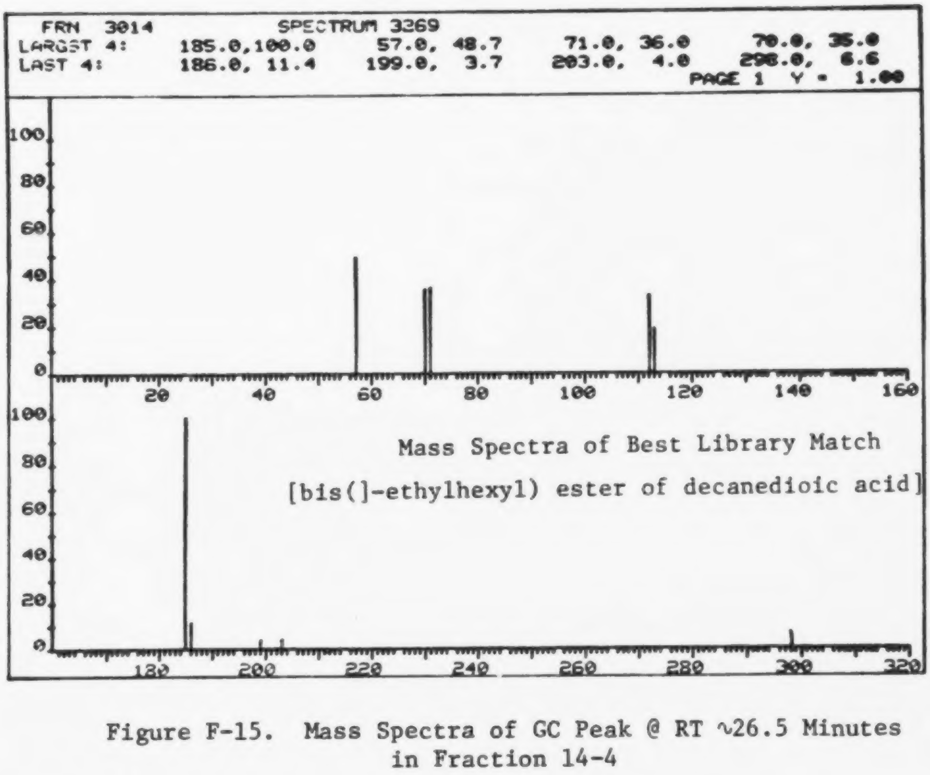
```
FRN  3008              SPECTRUM 2384
LARGST 4:        69.0,100.0      81.0, 32.3     136.0, 14.9      67.0, 14.5
LAST 4:         123.0,   4.1    136.0, 14.9     137.0,  7.1     231.0,  2.6
                                                       PAGE 1  Y = 1.00
```

Figure F-14. Mass Spectra of a GC Peak at RT ~27 Minutes in Fractions 4-2, 11-4 and 12-5



```
WORK AREA SPECTRUM    FRN  5124                               PAGE 1  Y =  1.00
LARGST 4:     185.1,100.0      57.1, 29.1       70.1, 27.7      71.1, 25.2
LAST 4:       303.1,  1.5     306.1,    .5     308.3,  1.9     315.1,  4.9
+1035-1045-1093
```

Mass Spectra of Peak

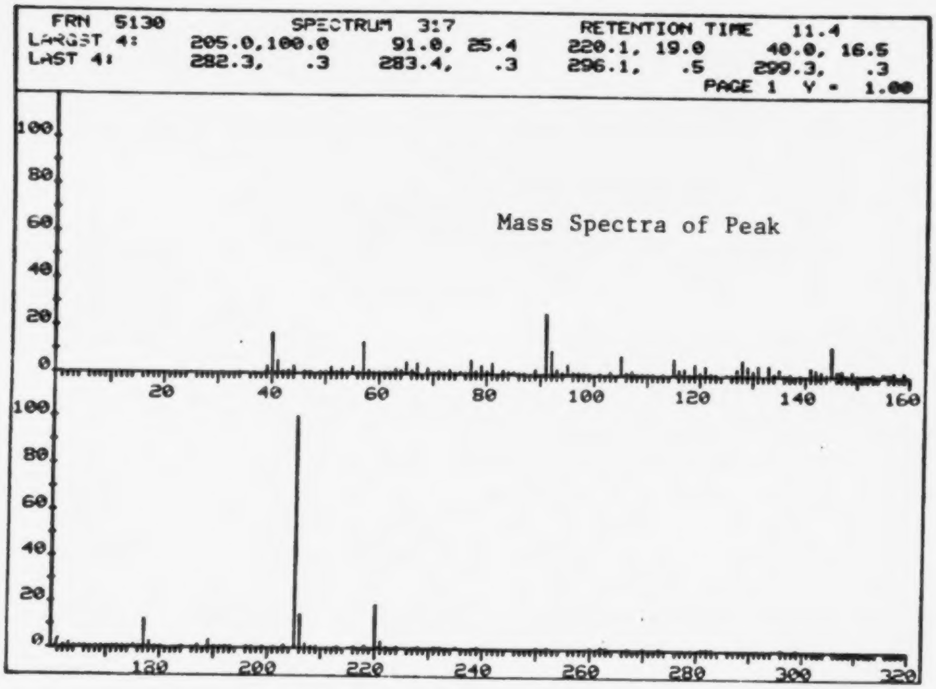


```
  FRN  3014              SPECTRUM 3269
LARGST 4:       185.0,100.0      57.0, 48.7      71.0, 36.0      70.0, 35.0
LAST 4:         186.0, 11.4     199.0,  3.7     203.0,  4.0     298.0,  6.6
                                                         PAGE 1  Y =  1.00
```

Mass Spectra of Best Library Match

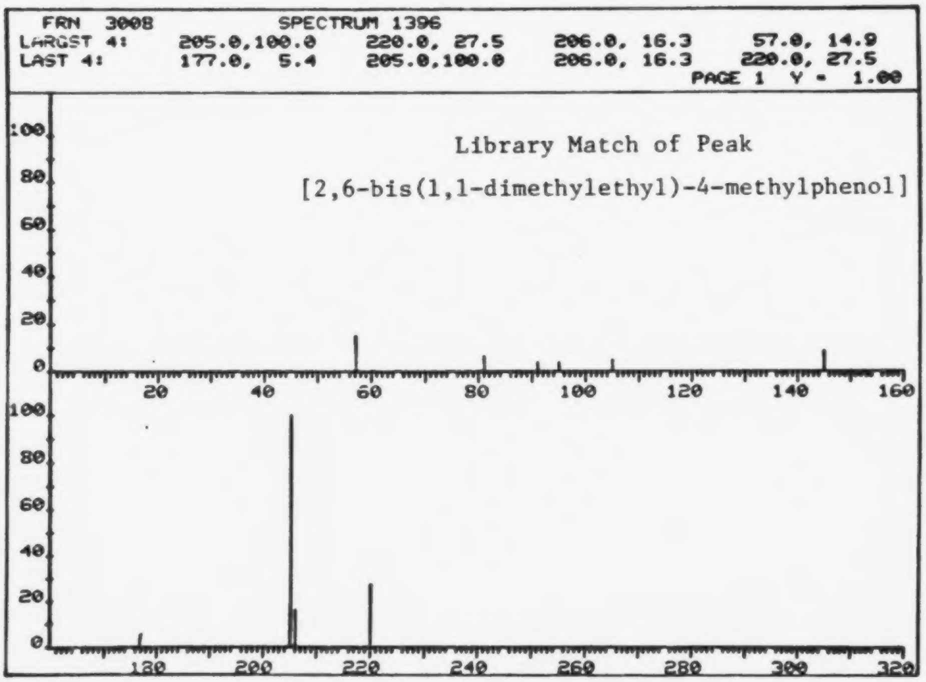
[bis(]-ethylhexyl) ester of decanedioic acid]

Figure F-15. Mass Spectra of GC Peak @ RT ∿26.5 Minutes in Fraction 14-4



```
FRN  5130            SPECTRUM  3:7            RETENTION TIME    11.4
LARGST 4:      205.0,100.0       91.0, 25.4     220.1, 19.0      40.0, 16.5
LAST 4:        282.3,    .3     283.4,    .3    296.1,   .5     299.3,    .3
                                                          PAGE 1  Y -  1.00
```

Mass Spectra of Peak



```
FRN  3008            SPECTRUM 1396
LARGST 4:      205.0,100.0      220.0, 27.5     206.0, 16.3      57.0, 14.9
LAST 4:        177.0,   5.4     205.0,100.0     206.0, 16.3     220.0, 27.5
                                                          PAGE 1  Y -  1.00
```

Library Match of Peak

[2,6-bis(1,1-dimethylethyl)-4-methylphenol]

Figure F-16. Mass Spectra of GC Peak @ RT ~11.5 Minutes in Fraction 15-4

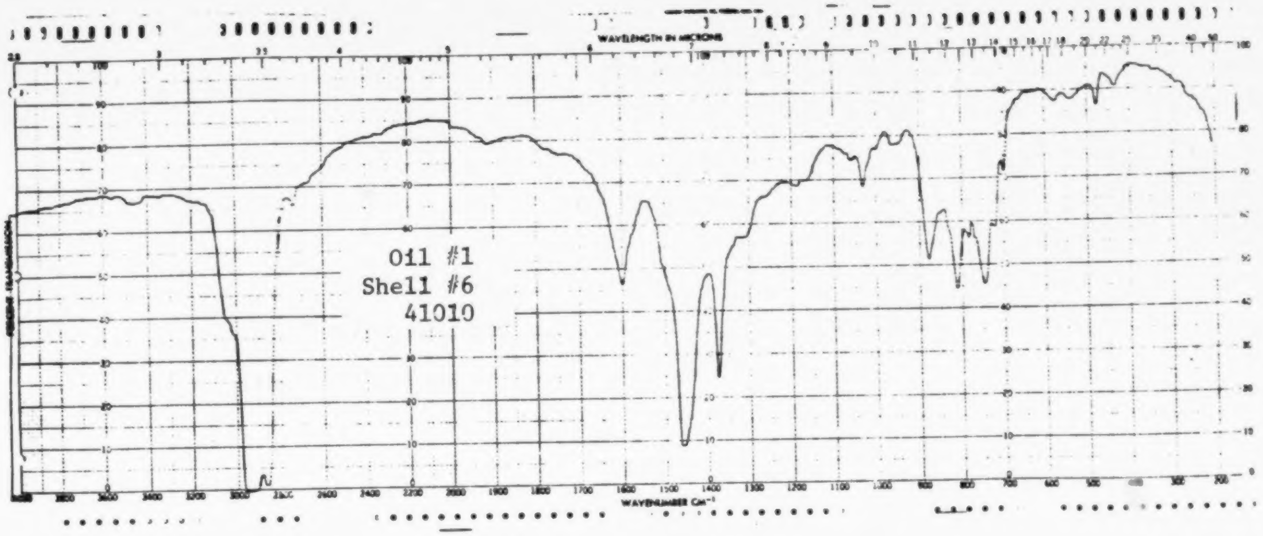
# APPENDIX G

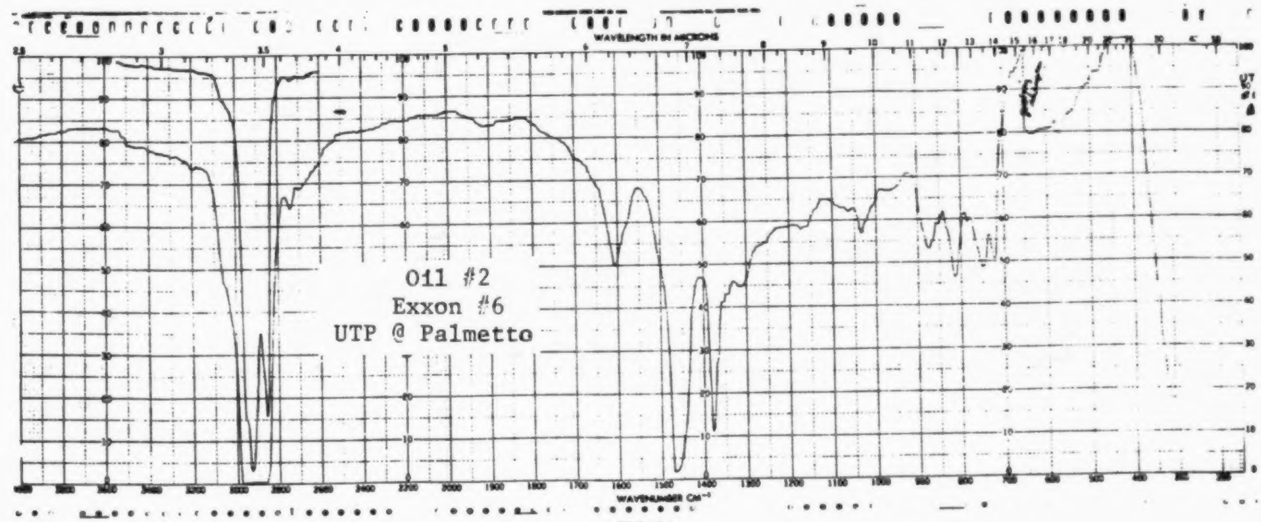
## INFRA-RED SPECTRA OF AS RECEIVED RESIDUAL FUEL OIL SAMPLES

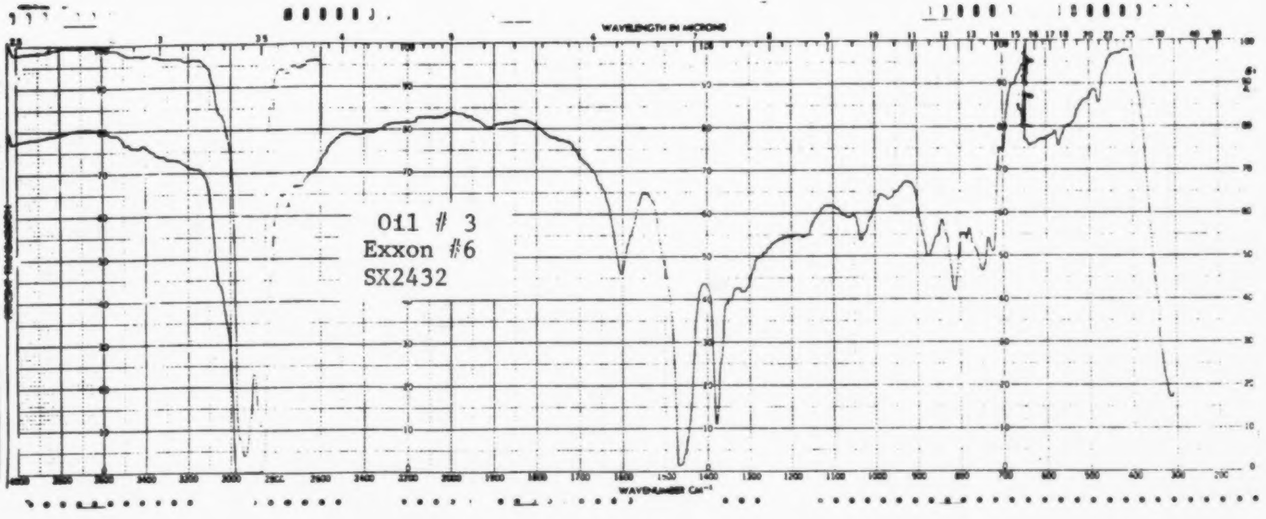
The infra-red spectra of the 36 as received residual fuel oil samples, discussed in Section 6 of this report, are presented here as Appendix G.

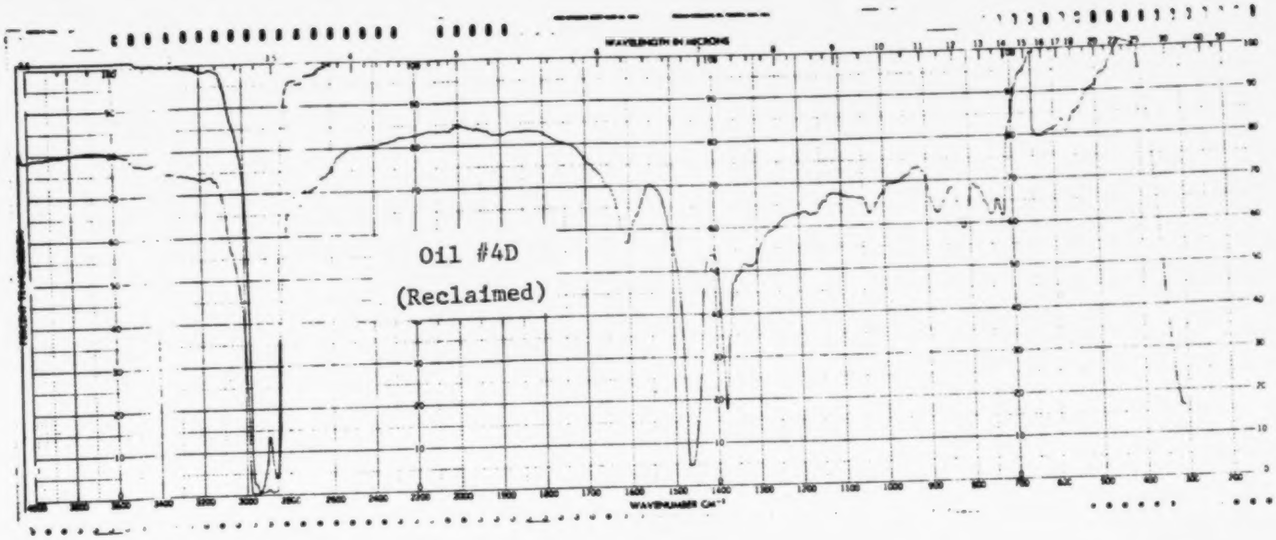
Legible copies of the data appearing in Appendix G, pages 725 through 736 can be obtained from:

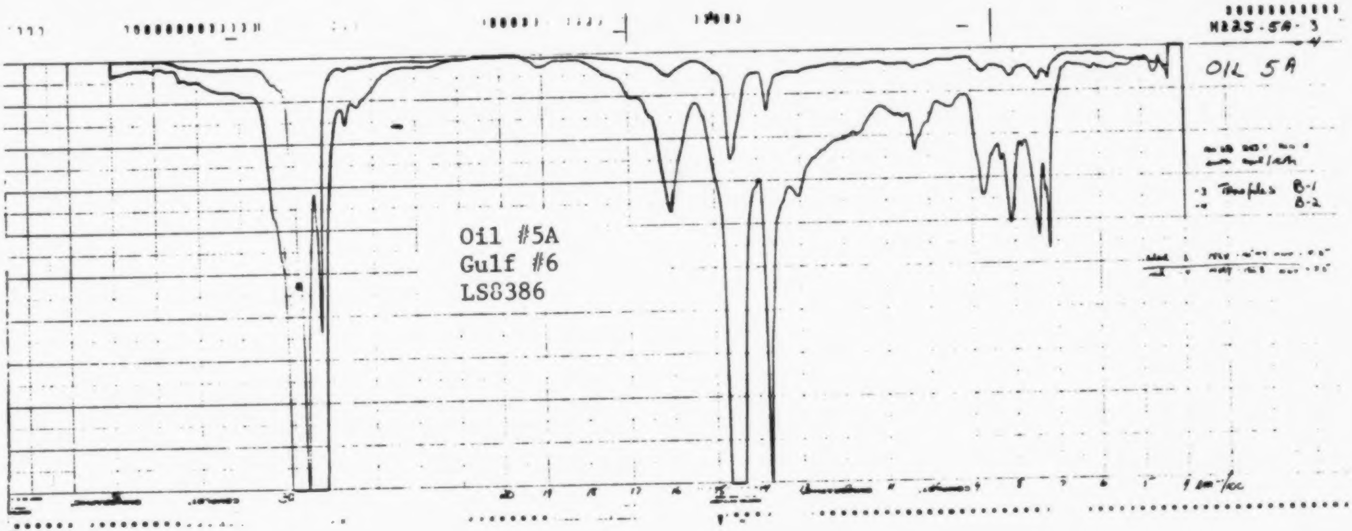
Mr. William Whelan
U.S. Environmental Protection Agency
Industrial Environmental Research Laboratory
Research Triangle Park, N.C. 27711

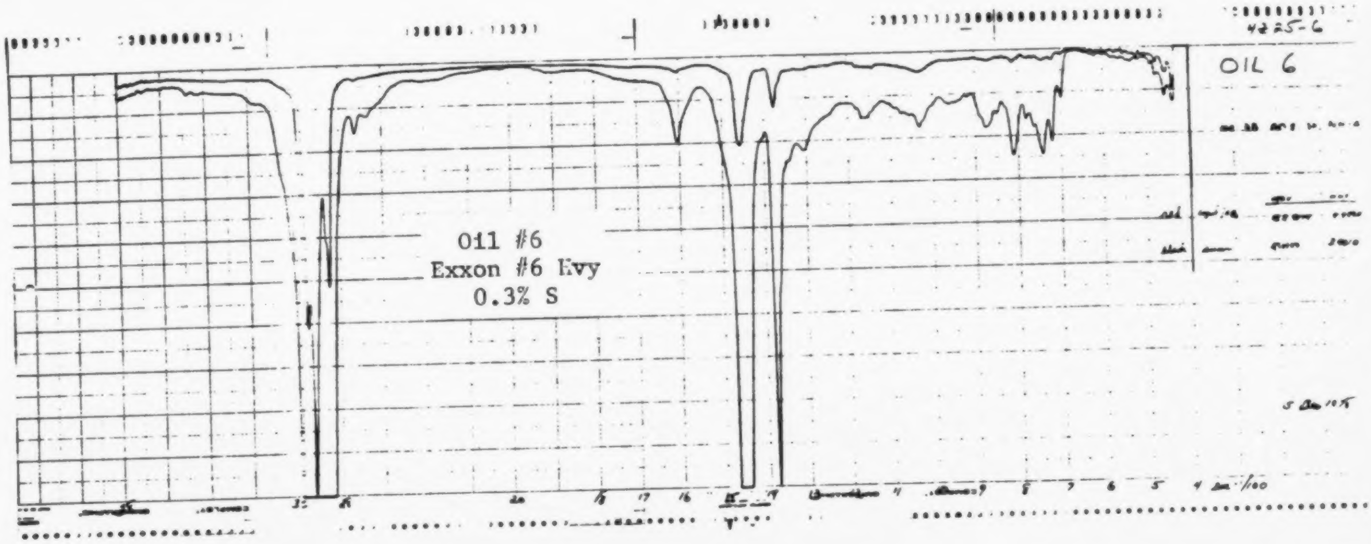

WAVELENGTH IN MICRONS
Oil #1
Shell #6
41010
WAVENUMBER CM⁻¹

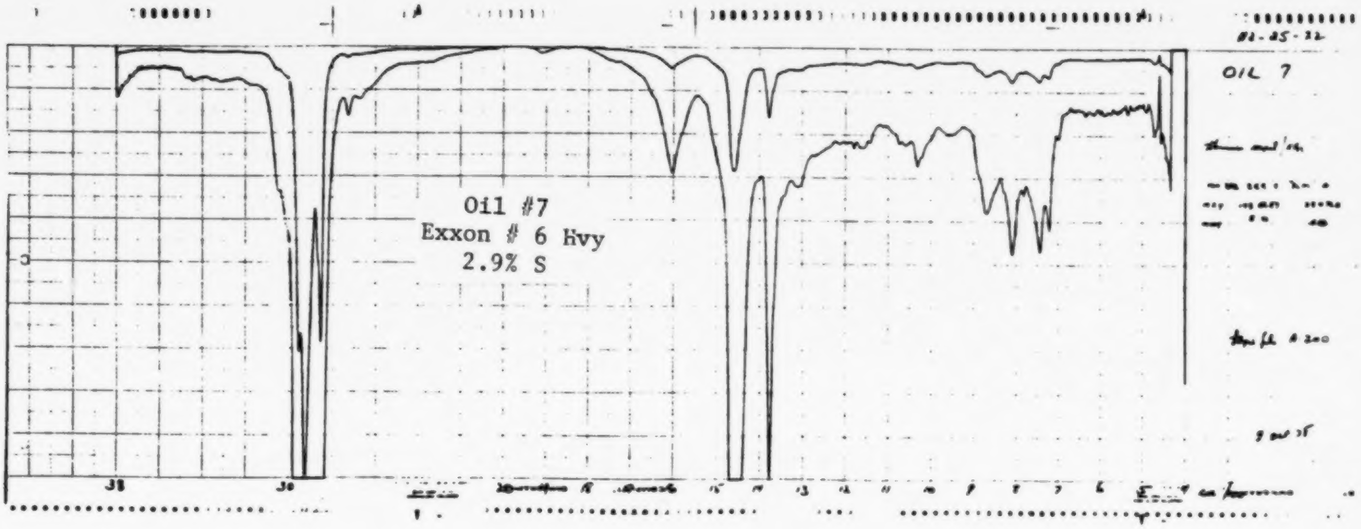

WAVELENGTH IN MICRONS
Oil #2
Exxon #6
UTP @ Palmetto
WAVENUMBER CM⁻¹


WAVELENGTH IN MICRONS
Oil # 3
Exxon #6
SX2432
WAVENUMBER CM⁻¹

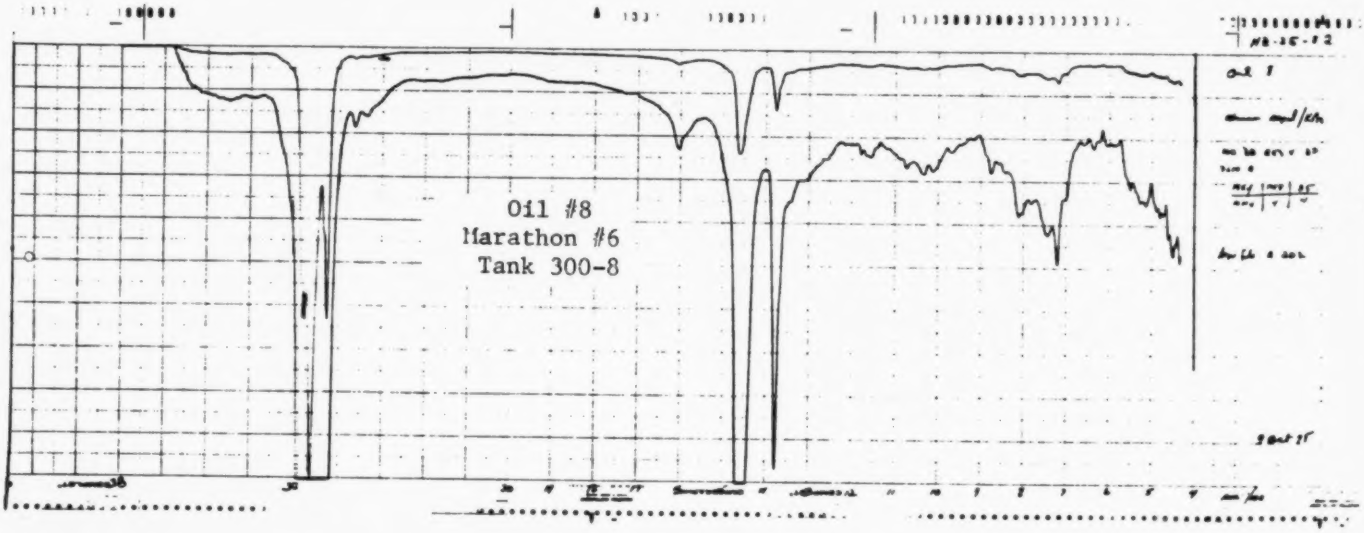

WAVELENGTH IN MICRONS
Oil #4D
(Reclaimed)
WAVENUMBER CM⁻¹


4225-5A-3
OIL 5A
Oil #5A
Gulf #6
LS8386

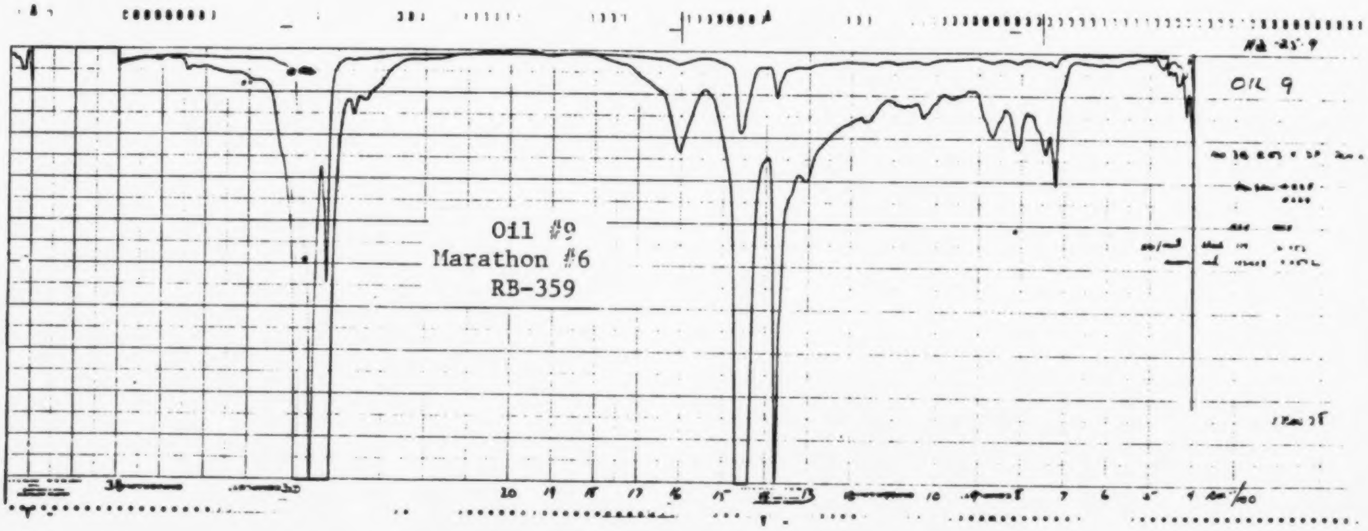

4225-6
OIL 6
Oil #6
Exxon #6 Hvy
0.3% S



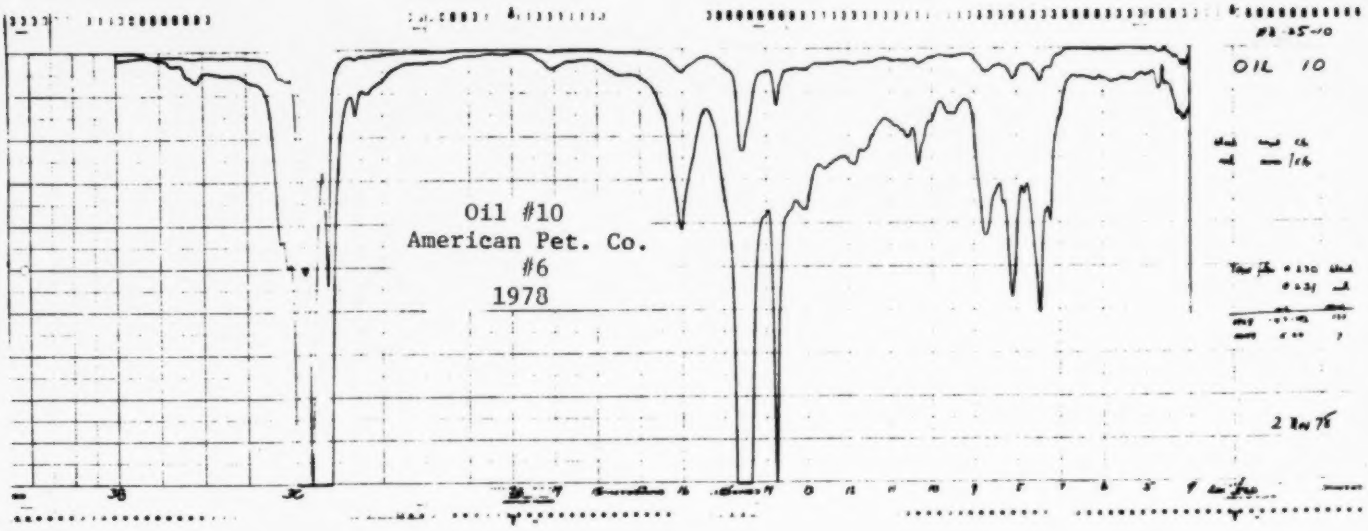
Oil #7
Exxon # 6 Hvy
2.9% S



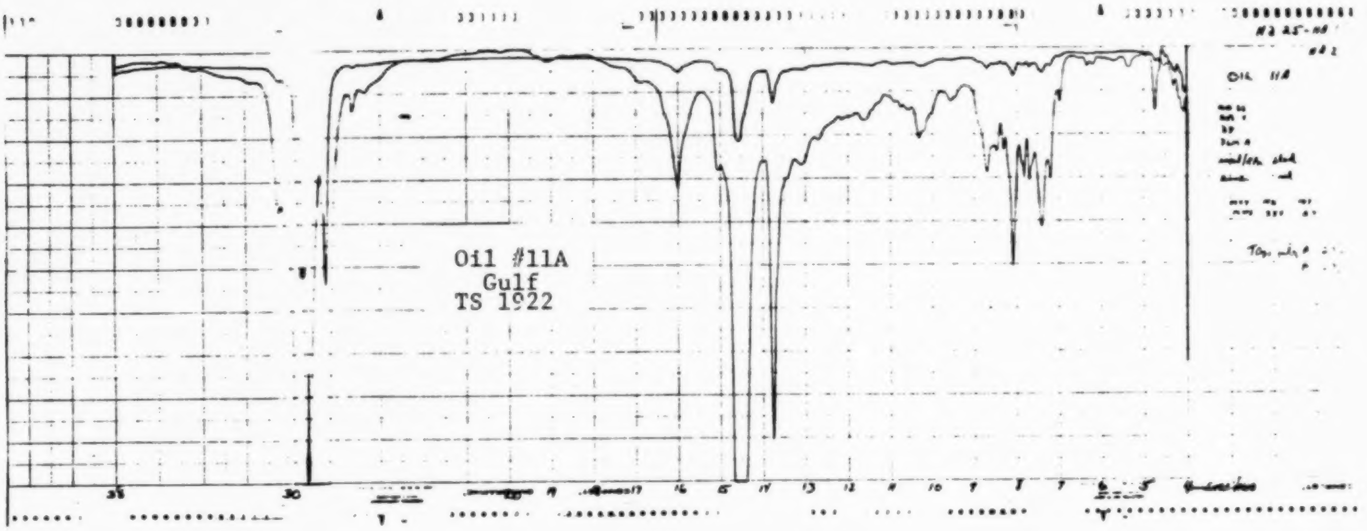
Oil #8
Marathon #6
Tank 300-8



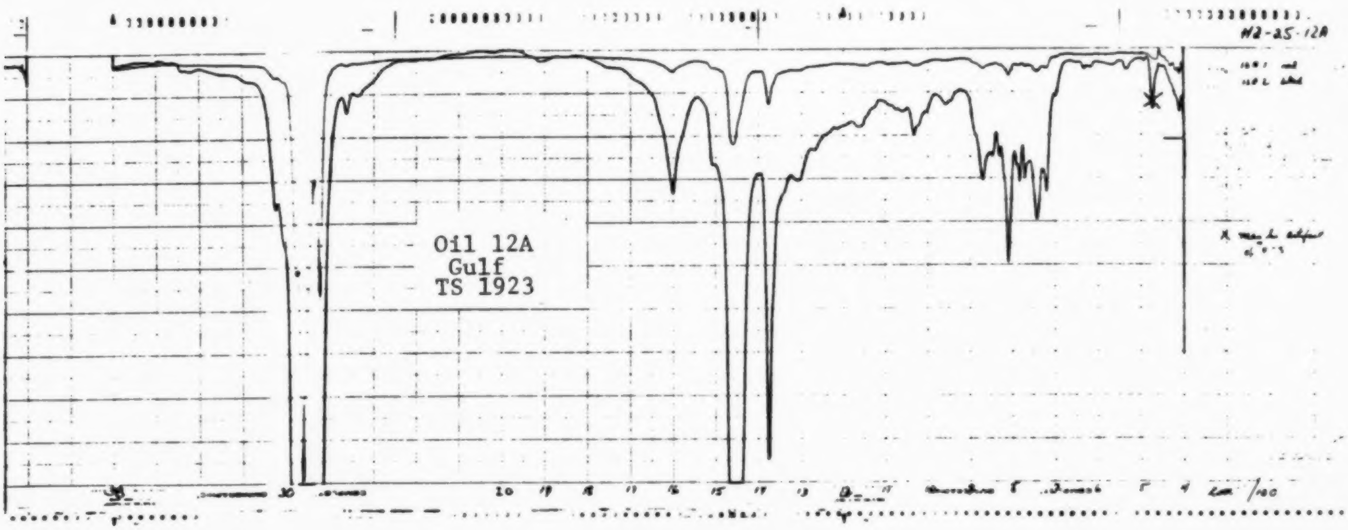
Oil #9
Marathon #6
RB-359



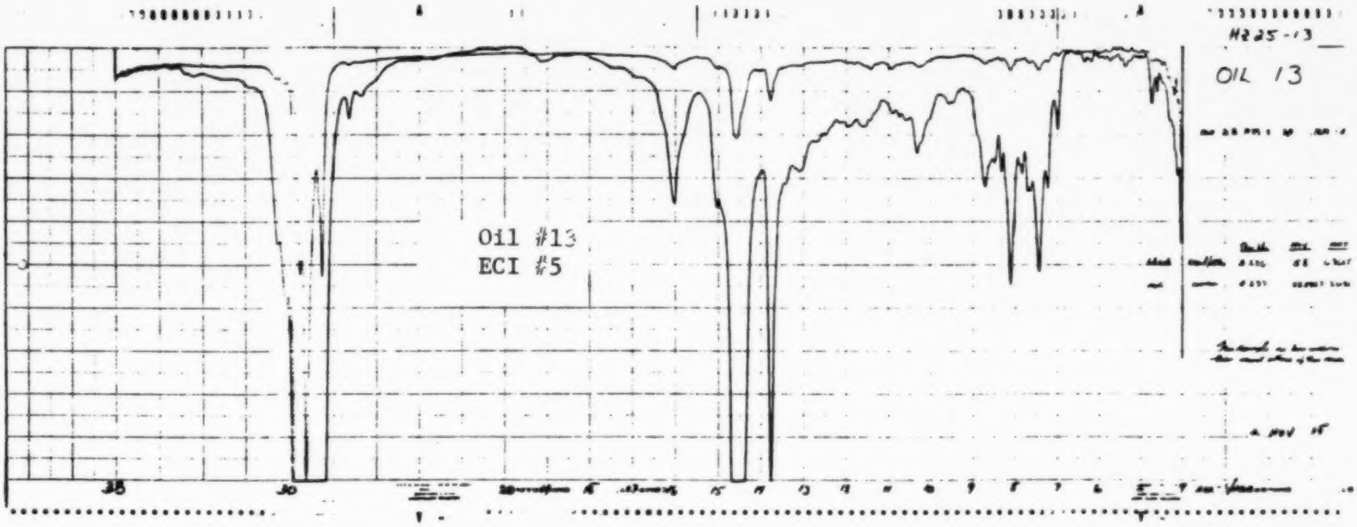
Oil #10
American Pet. Co.
#6
1978

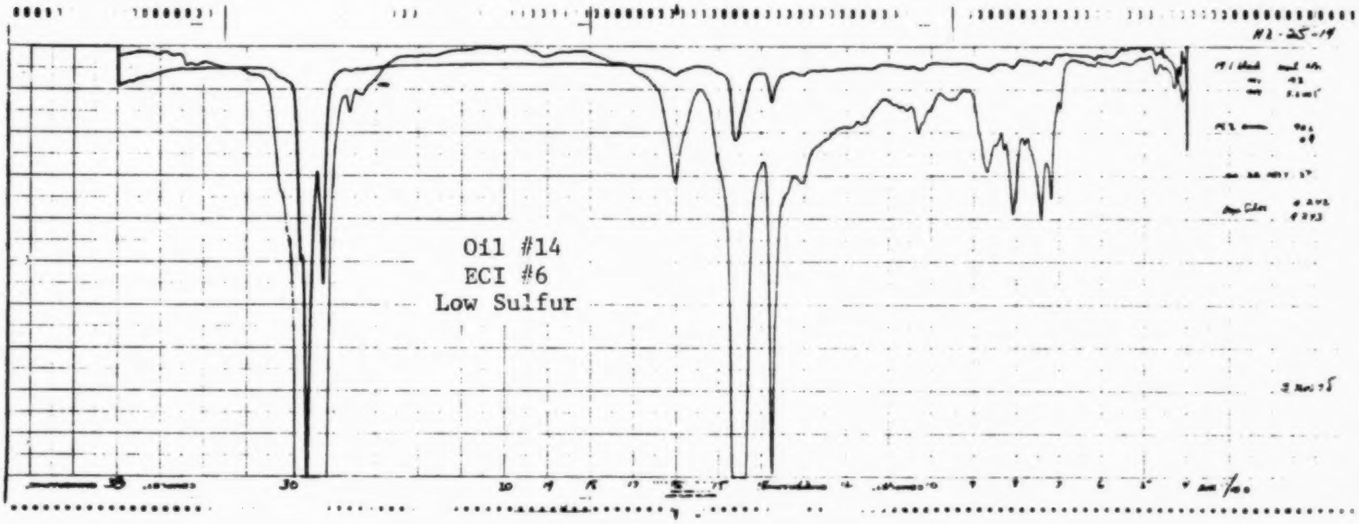


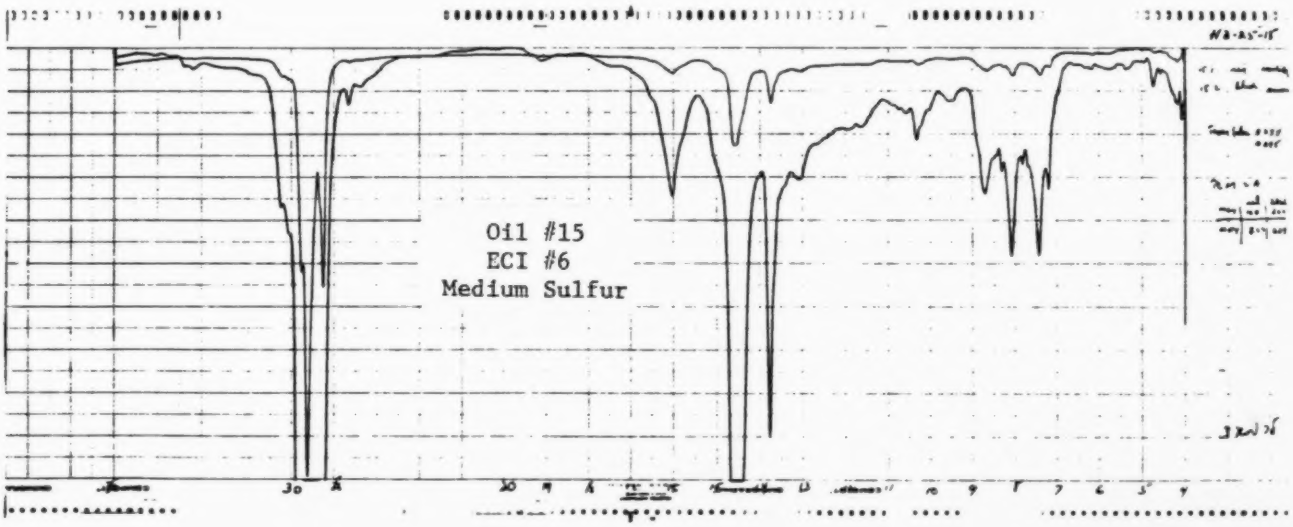
Oil #11A
Gulf
TS 1922

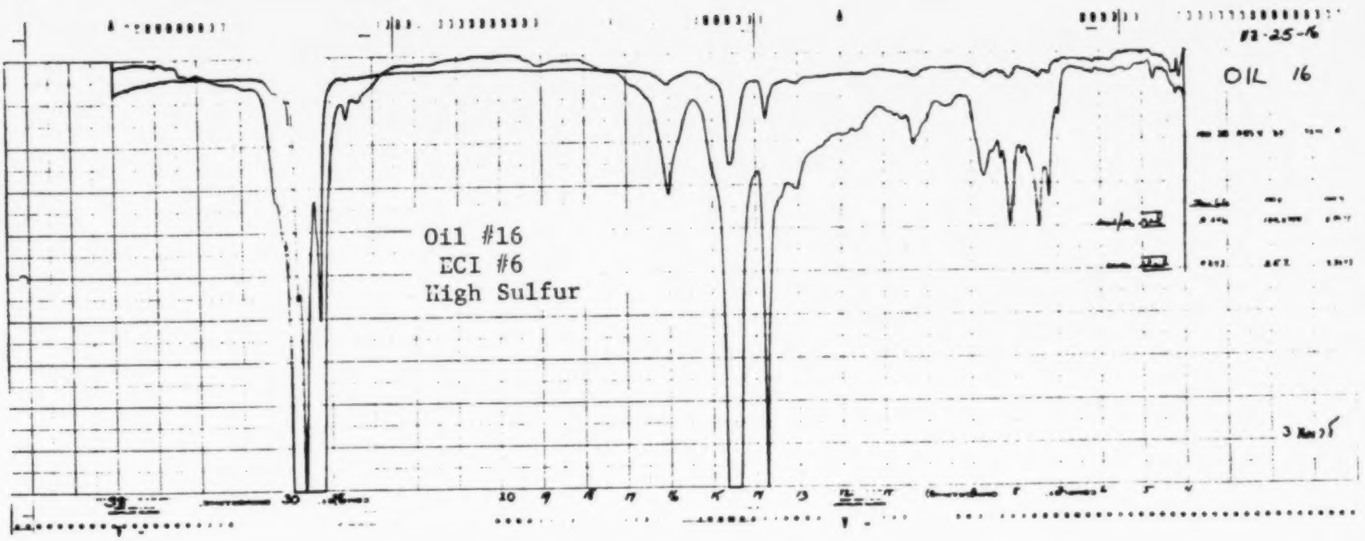


Oil 12A
Gulf
TS 1923

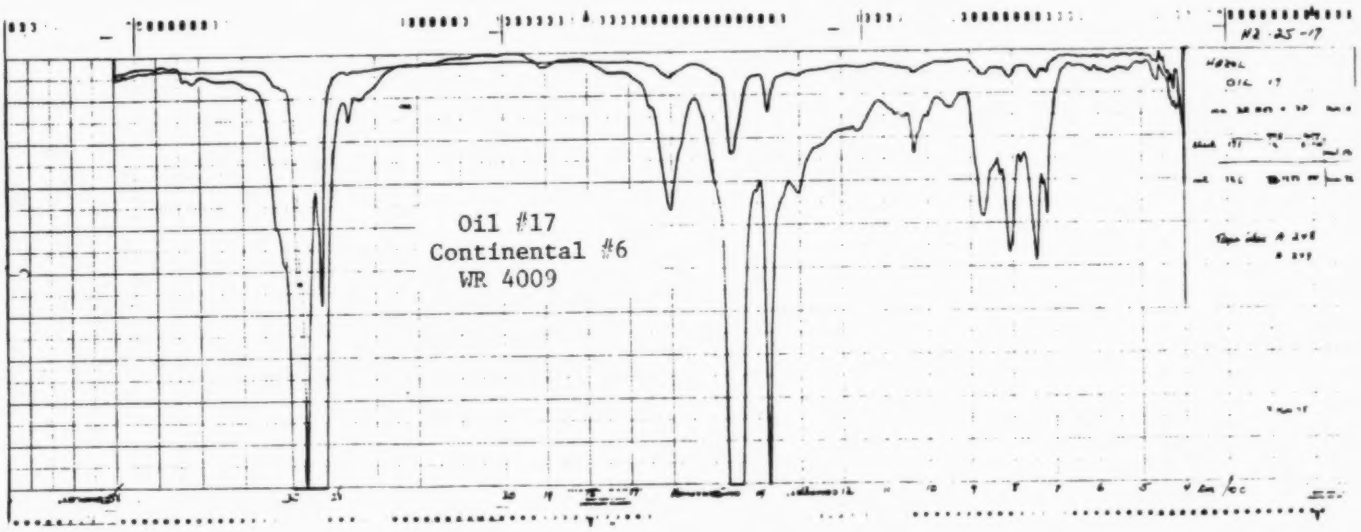

Oil #13
ECI #5


Oil #14
ECI #6
Low Sulfur

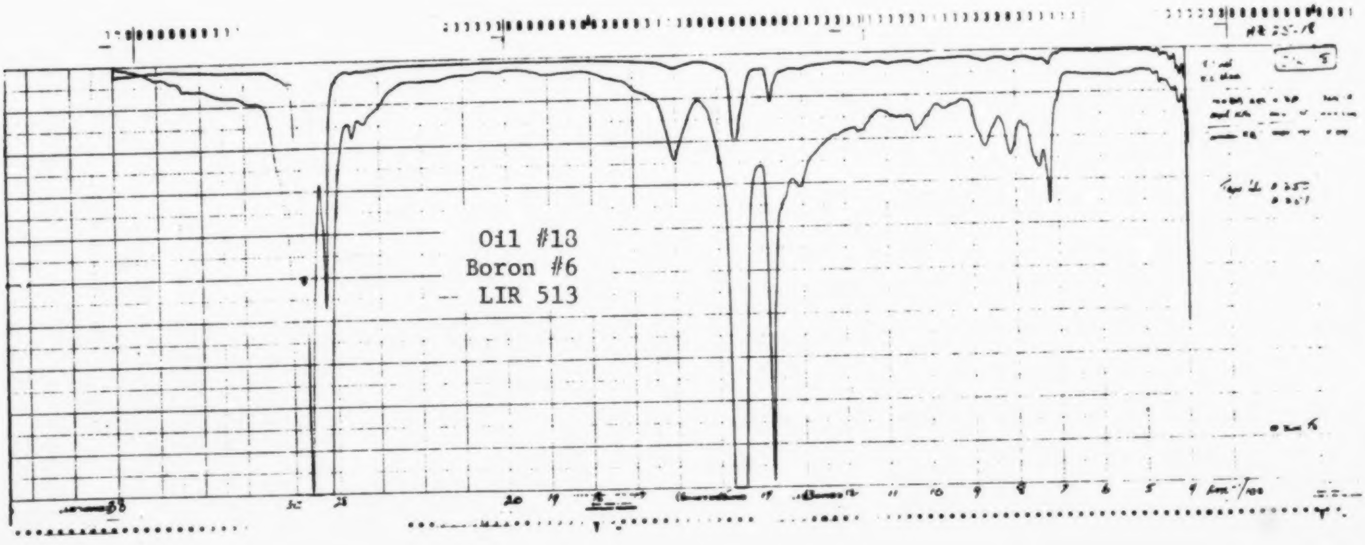

Oil #15
ECI #6
Medium Sulfur



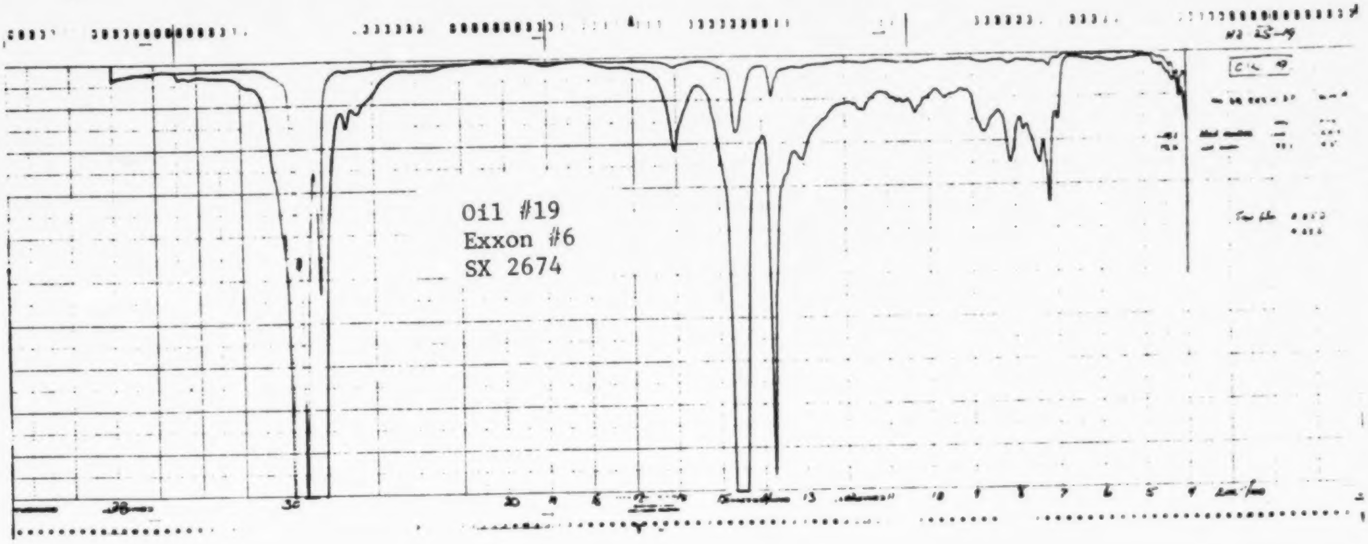
Oil #16
ECI #6
High Sulfur



Oil #17
Continental #6
WR 4009



Oil #18
Boron #6
LIR 513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Exxon #6
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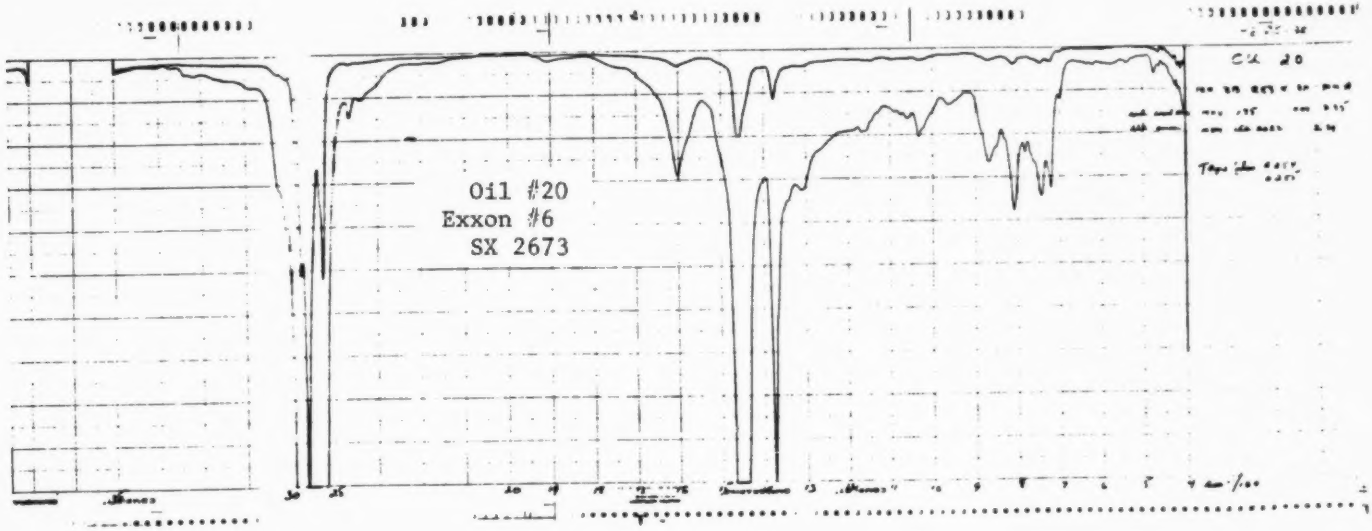
30
20
13
10
9
8
7
6
5
4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Exxon #6
SX 2673
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25
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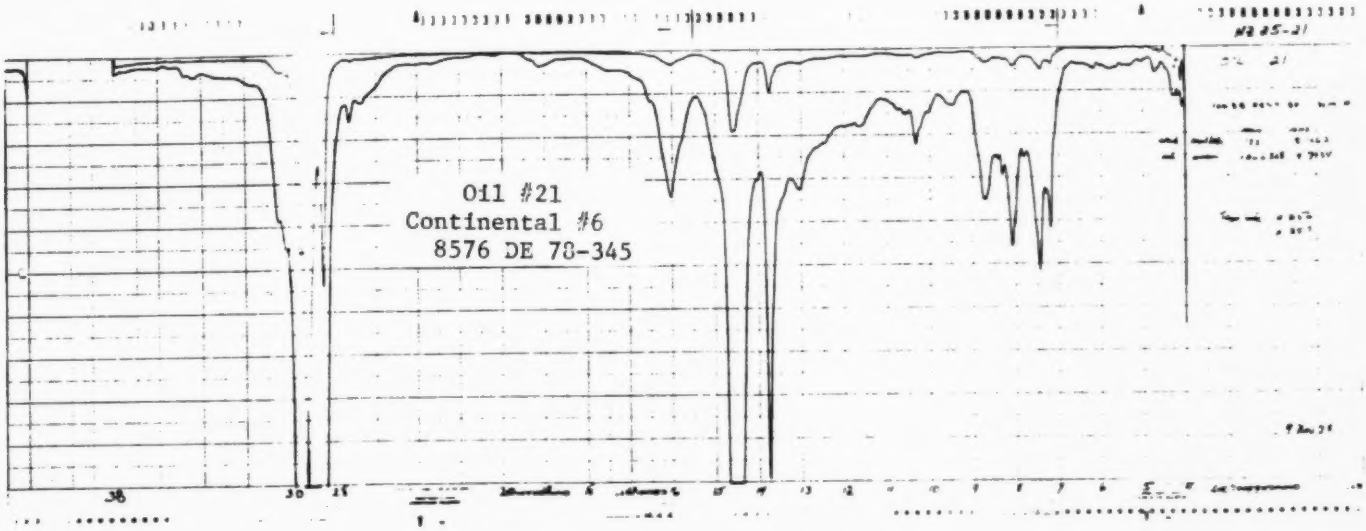
5
4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Continental #6
8576 DE 78-345
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30
25
15
14
13
12
10
9
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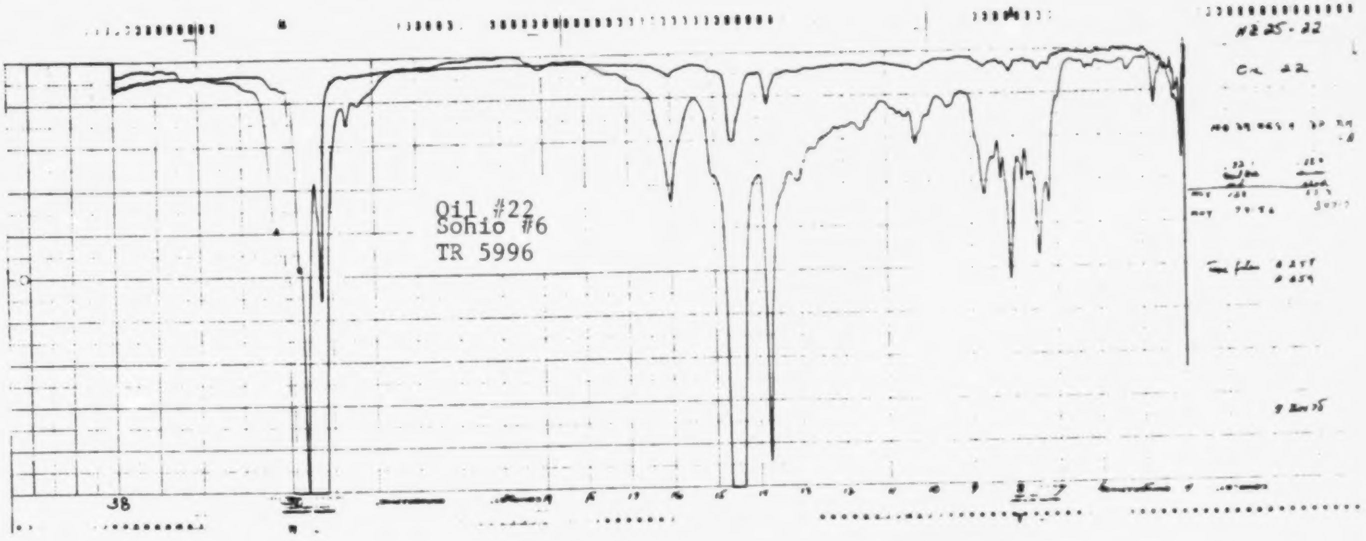
7
6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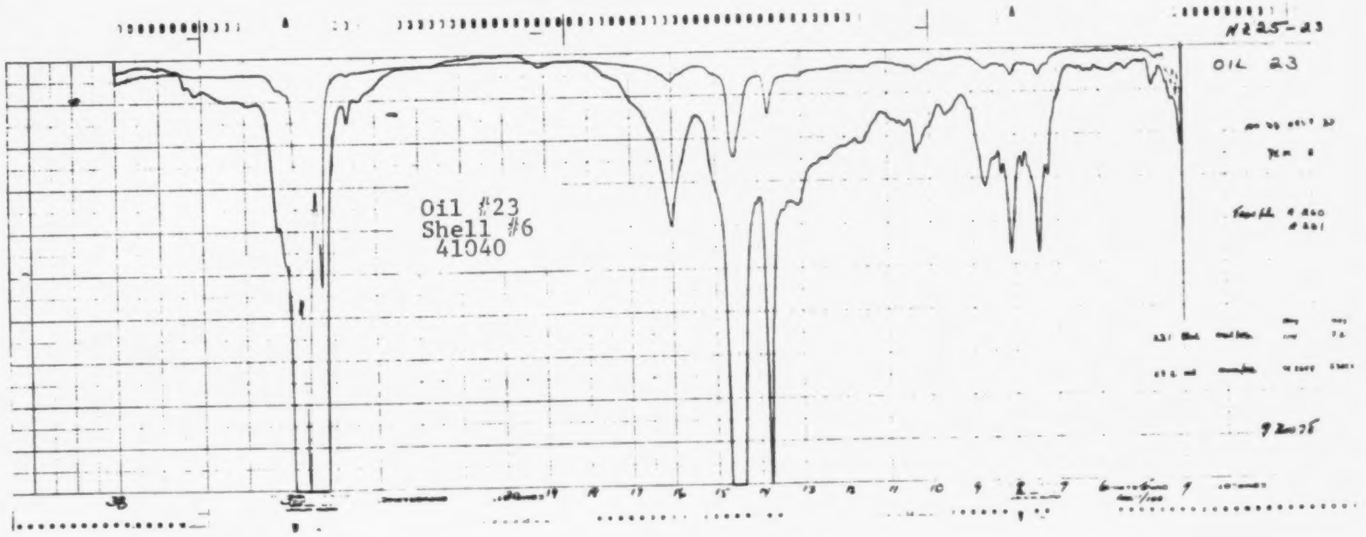
Oil 22
Oil #22
Sohio #6
TR 5996
38
9 Dec 75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Oil #23
Shell #6
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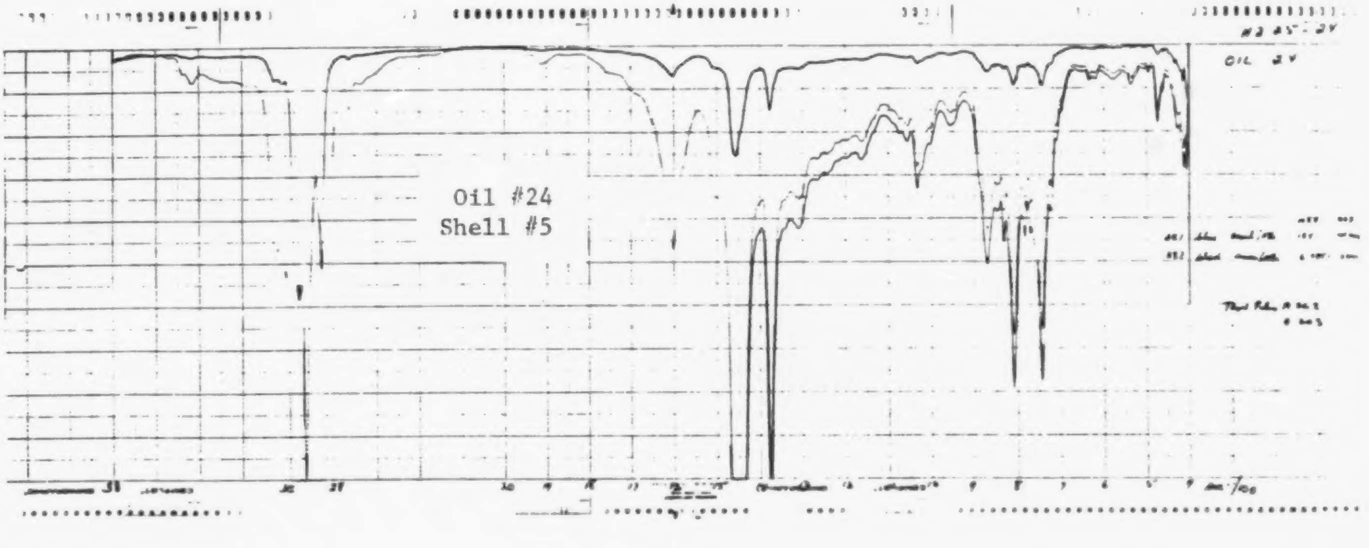
38
9 Dec 75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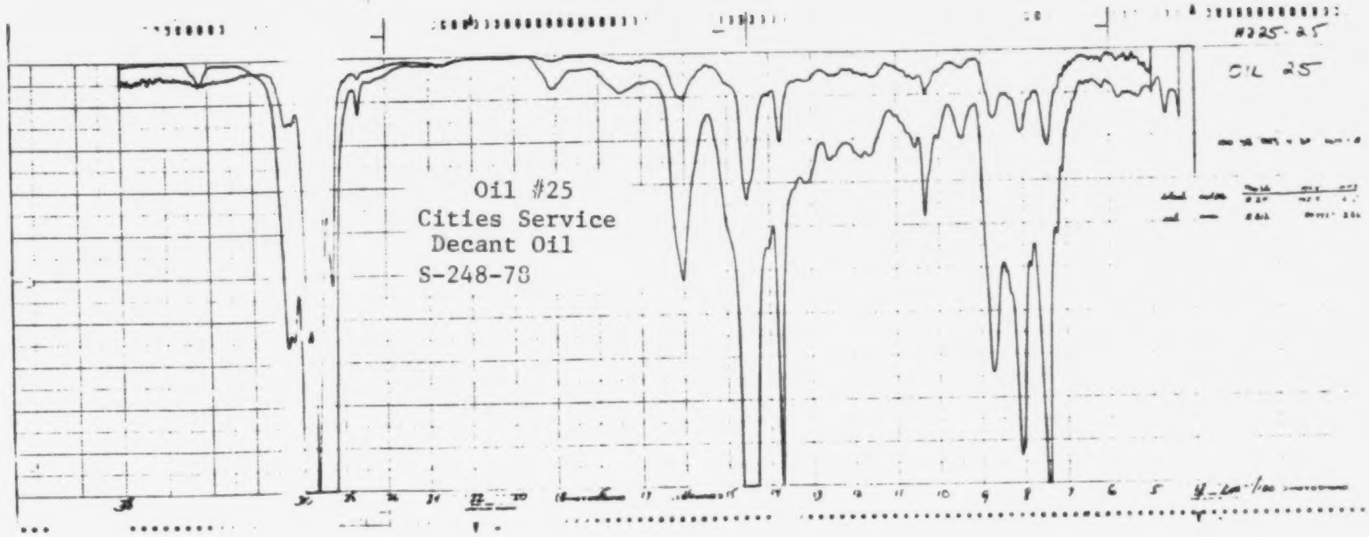
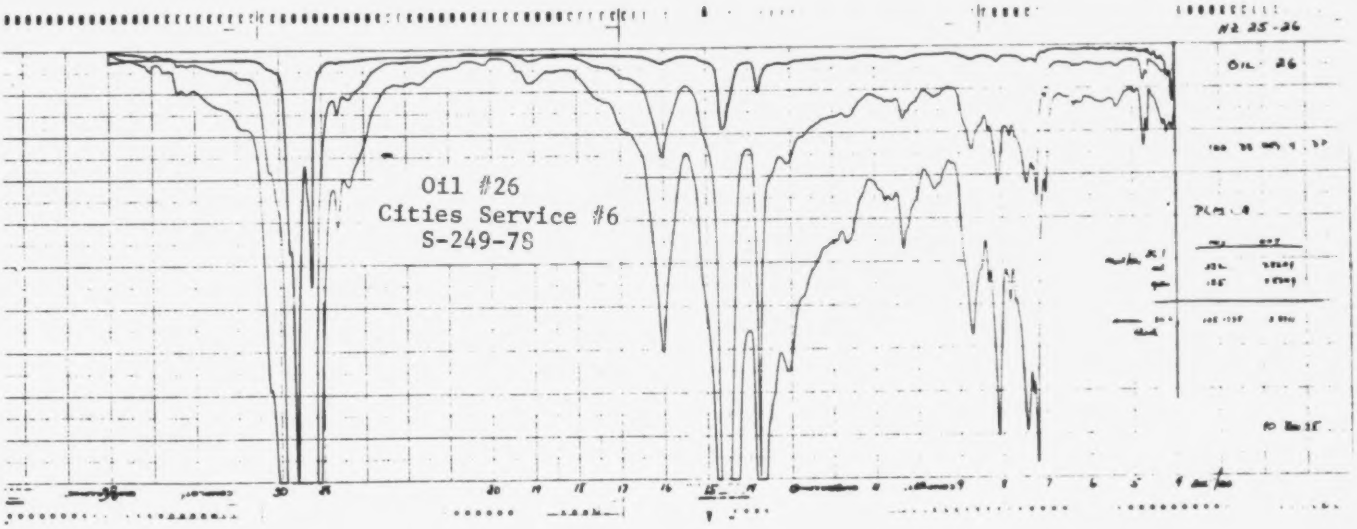
OIL 24
Oil #24
Shell #5


Oil #25
Cities Service
Decant Oil
S-248-78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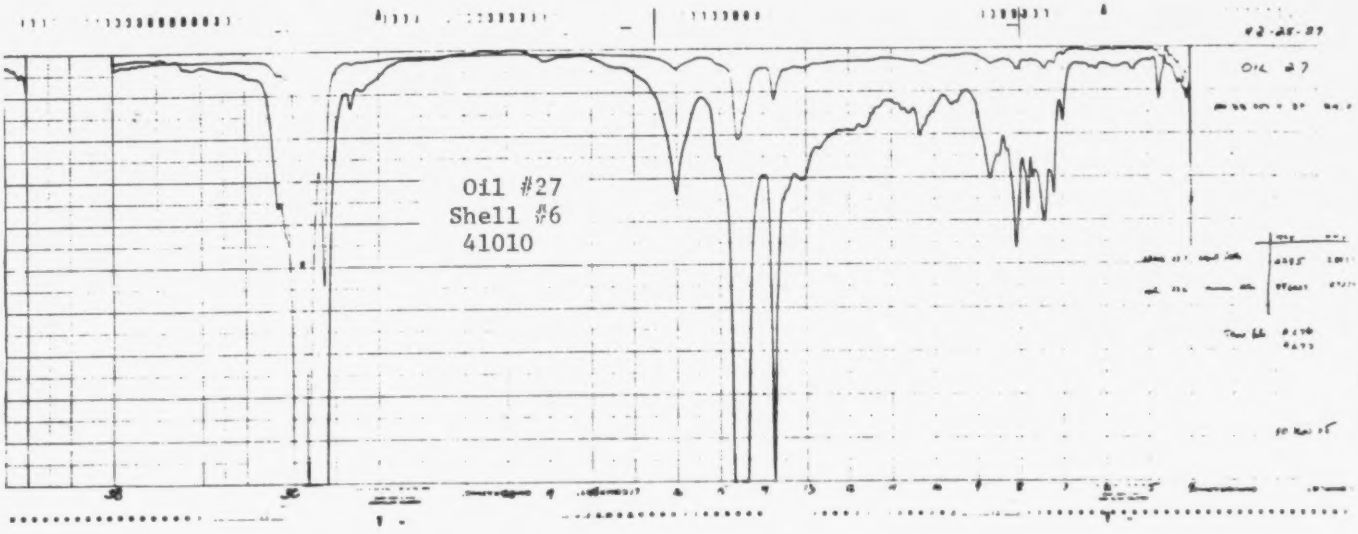
Cities Service #6
S-249-78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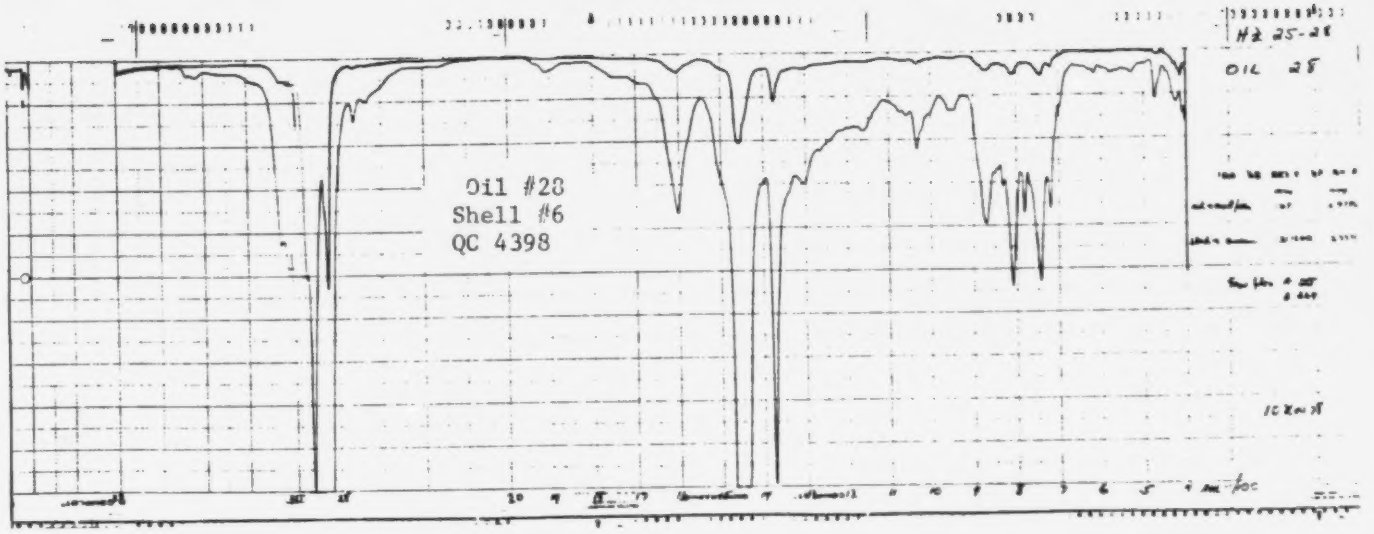
Shell #6
41010


#Z 25-28
OIL 28
Oil #28
Shell #6
QC 4398
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19
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11
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8
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6
5
4
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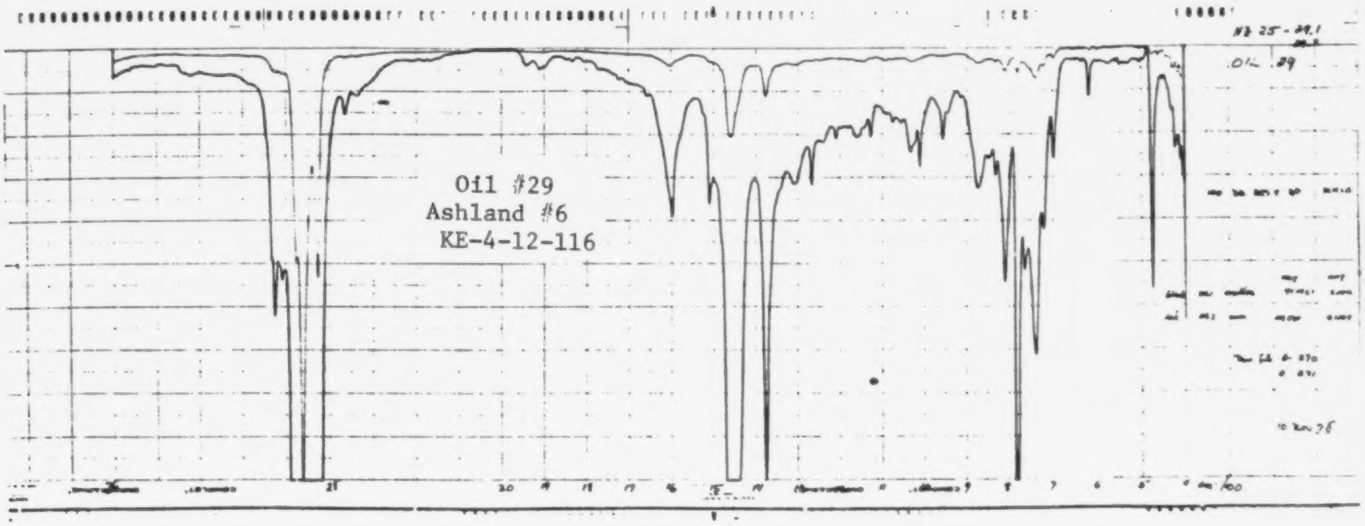
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Oil #29
Ashland #6
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14
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5
4
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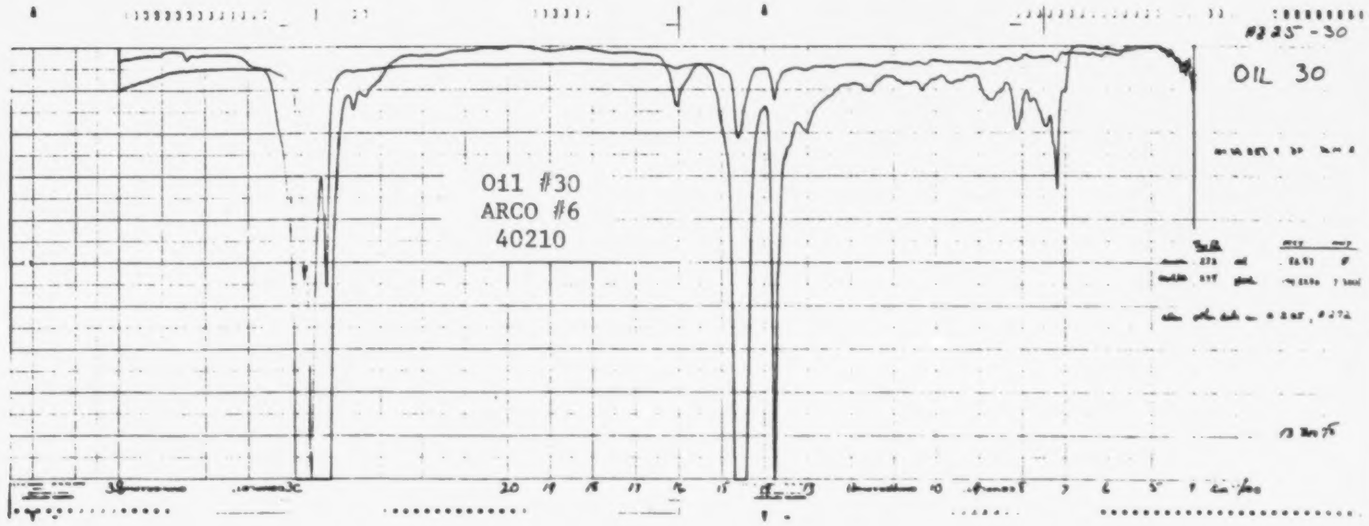
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Oil #30
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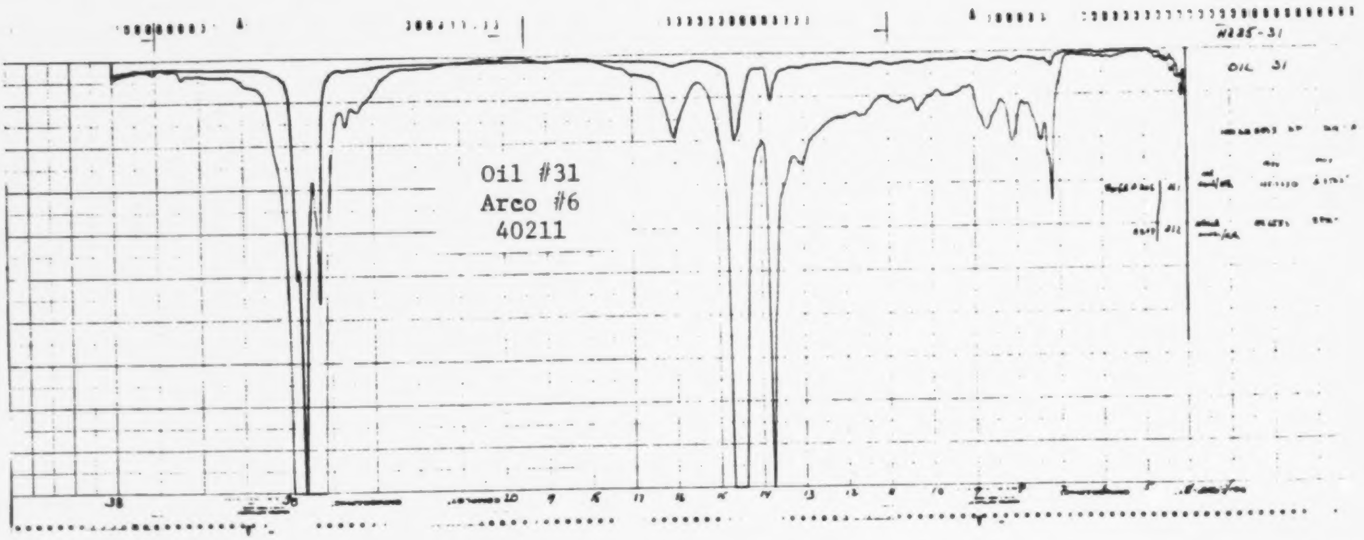
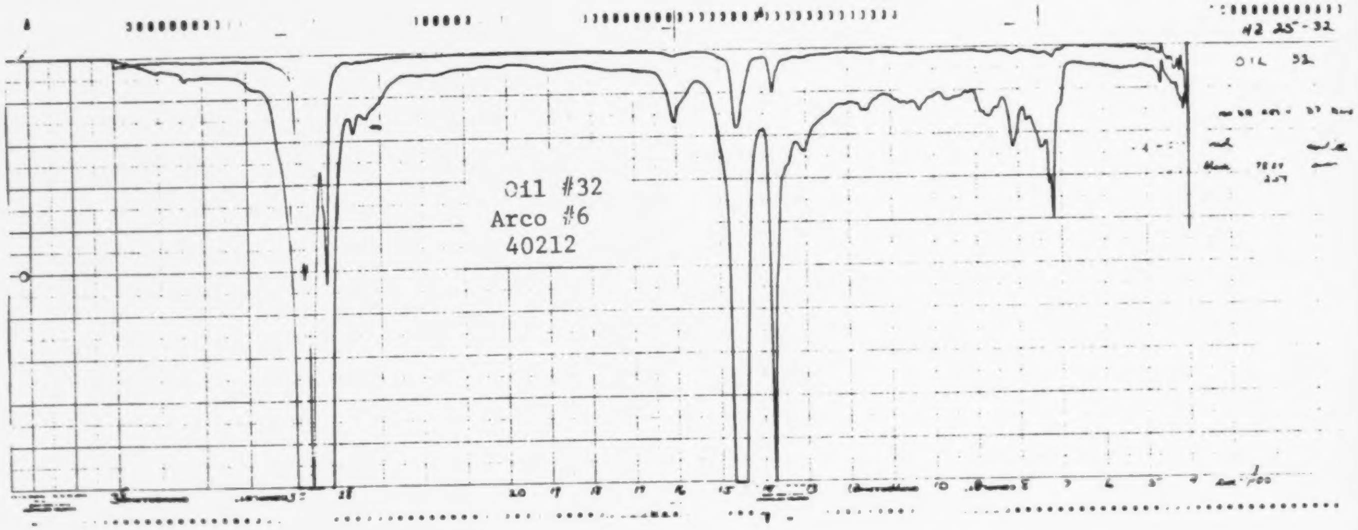
100



Oil #31
Arco #6
40211



Oil #32
Arco #6
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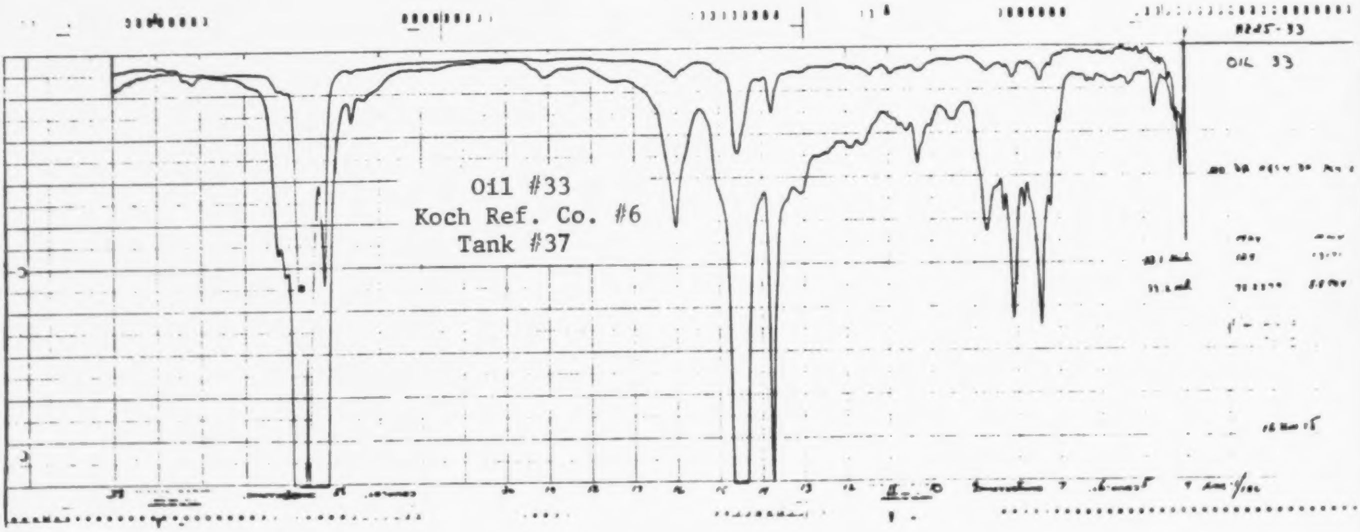
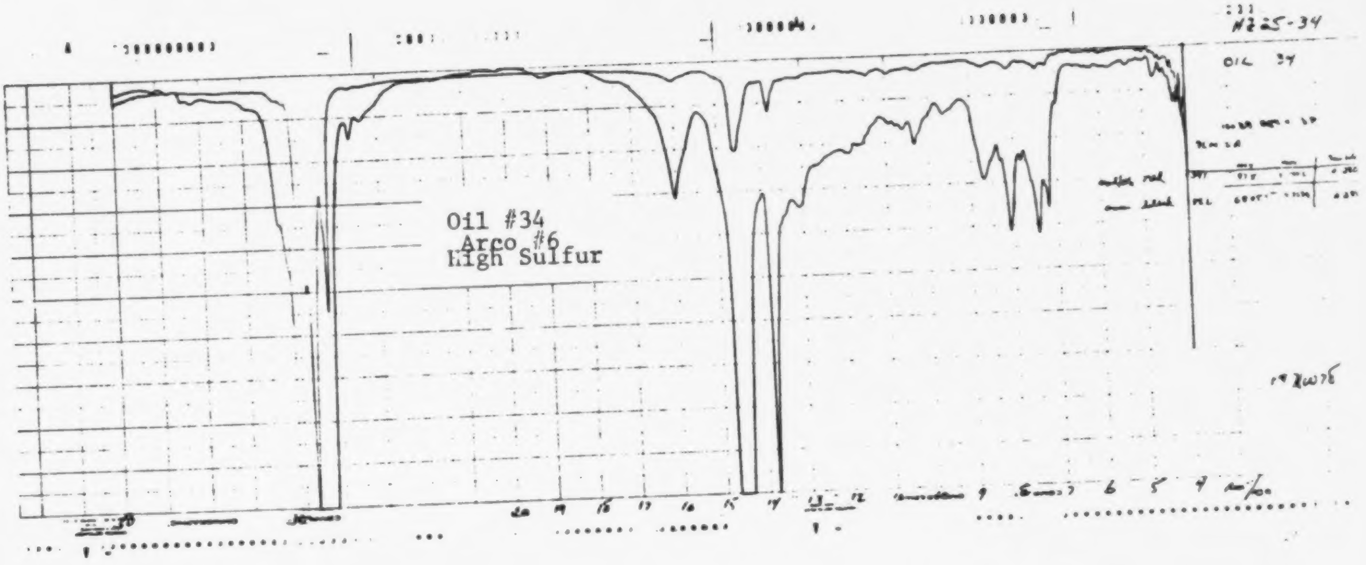
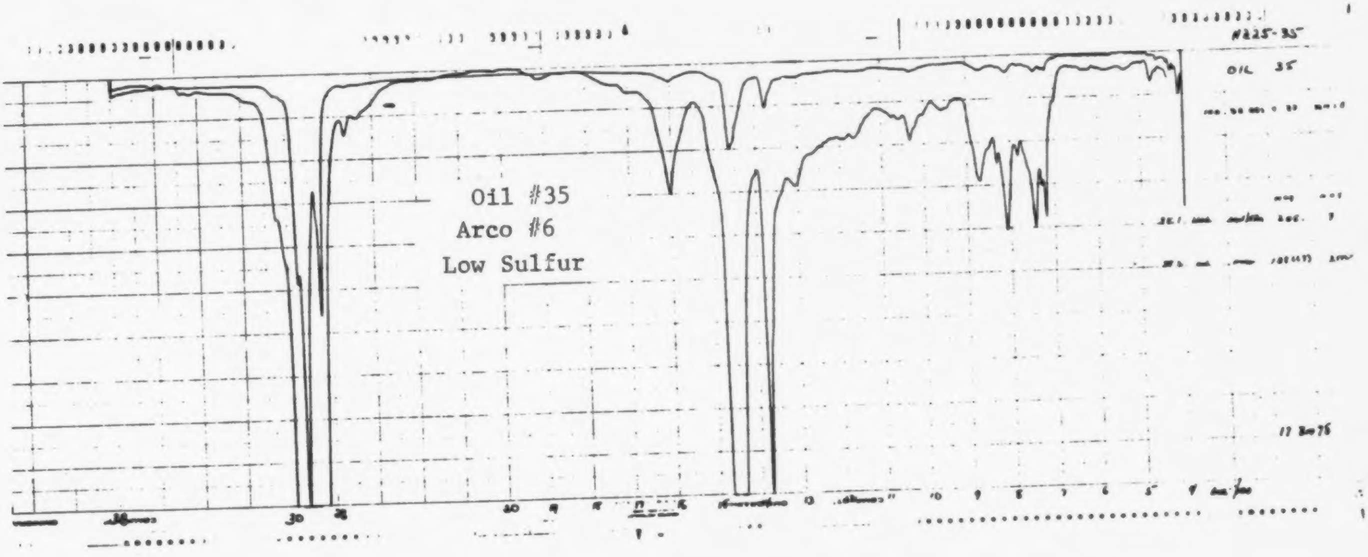
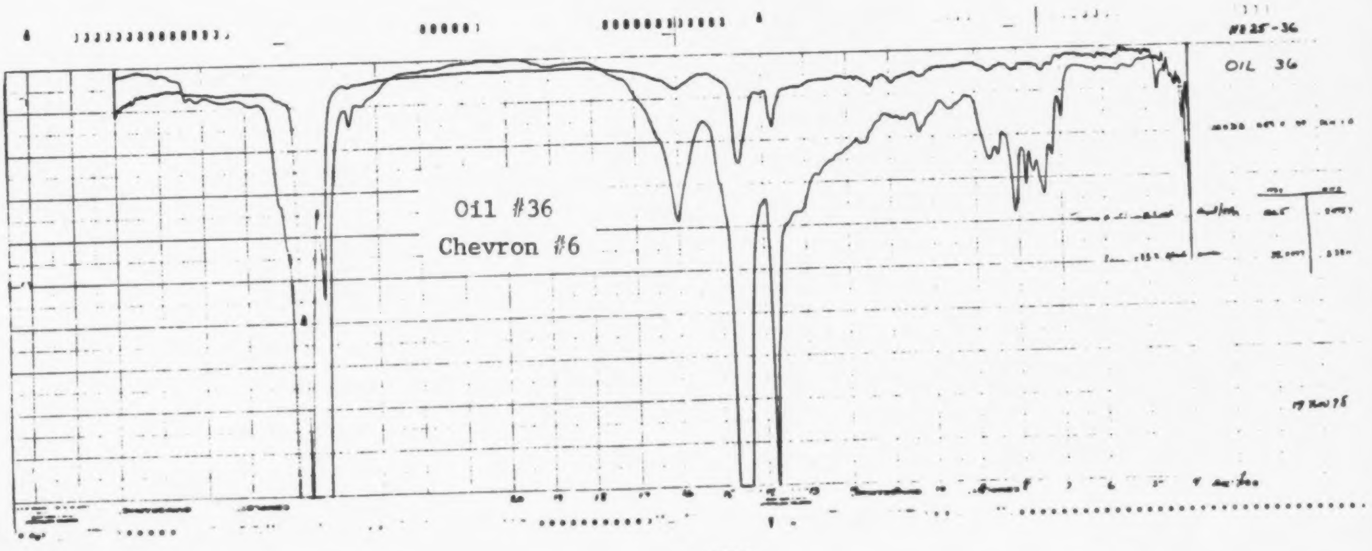


Oil #33
Koch Ref. Co. #6
Tank #37


Oil #34
Arco #6
High Sulfur


Oil #35
Arco #6
Low Sulfur


Oil #36
Chevron #6

# APPENDIX H

## MAJOR WORLDWIDE OIL FIELDS

The following is republished from the "International Petroleum Encyclopedia (1976) by the Petroleum Publishing Company of Tulsa, Oklahoma.

# Major worldwide oil fields

(• indicates offshore)

| Country | Field, disc. date | No. wells | 1975 prod. | Millions of bbl<br>Cumulative production 1/1/76 | Estimated reserves 1/1/76 | Pay, ft | API gravity* | Sulfur wt % |
|---|---|---|---|---|---|---|---|---|
| ABU DHABI | Asab, 1965 | 32 | 90 | 179 | 500 | , 7,500 | 40.0 | |
| | Bu Hasa, 1962 | 49 | 156 | 1,227 | 1,789 | , 8,500 | 40.0 | |
| | • Mulbarras, 1971 | 15 | 7 | 14 | 150 | , 11,000 | 37.8 | |
| | • Umm Shaif, 1958 | 36 | 59 | 543 | 1,706 | , 9,150 | 40.0 | .... |
| | • Zakum, 1964 | 46 | 82 | 660 | 1,314 | , 9,100 | 40.0 | .... |
| ALGERIA | Edjeleh, 1956 | 130 | 7 | 168 | 128 | Camb.-Ord., 3,000 | 35.0 | .... |
| | El Gassi el Agreb, 1959 | 22 | 15 | 190 | 125 | Camb. 9,800 | 47.0 | .... |
| | Hassi Messaoud, N., 1956 | 108 | 81 | 953 | 4,685 | Cambrian, 11,000 | 49.0 | 0.15 |
| | Hassi Messaoud, S., 1956 | 145 | 28 | 1,222 | 4,532 | Cambrian, 11,000 | 49.0 | .... |
| | Rhourde El Baguel, 1962 | 17 | 4 | 251 | 209 | Camb., 3,182 | 40.0 | .... |
| | Zarzaitaine, 1958 | 70 | 33 | 911 | 552 | Dev., Carb. 4,600 | 42.0 | .... |
| | Tin Foye, 1961 | 44 | 3 | 146 | 40 | ......., 2,040 | 41.0 | .... |
| ARGENTINA | Chubut, 1907 | 5 | 27 | 613 | 110 | Cretaceous, 6,000 | 22.8 | .... |
| | Mendoza, 1943 | 803 | 36 | 577 | 198 | Triassic, 8,000 | | .... |
| | Neuquen, 1918 | 350 | 15 | 207 | 148 | Dogger J, 6,000 | 30 | .... |
| | Rio Negro, 1960 | 450 | 21 | 202 | 171 | , 2,800 | .... | .... |
| | Salta, 1928 | 75 | 1 | 86 | 48 | ......., 1,100-15,000 | 54 | .... |
| | Santa Cruz, 1944 | 2,340 | 25 | 544 | 161 | Neocomian, 6,000 | 41.8 | .... |
| AUSTRALIA | Barrow, 1964 | 289 | 13 | 126 | 105 | Windalia, J., 2,200-6,700 | 37.8 | .... |
| | • Barracouta, 1968 | 2 | 2 | 12 | 1 | Latrobe Valley, Eo., Olig., 4,700 | 63.0 | |
| | • Halibut, 1967 | 7 | 49 | 317 | 348 | Latrobe Valley, Eo., Olig., 7,600 | 43.0 | |
| | • Kingfish, 1967 | 40 | 43 | 315 | 745 | Latrobe Valley, Eo., Olig., 7,500 | 46.9 | |
| AUSTRIA | Matzen, 1949 | 836 | 8 | 322 | 94 | Badenian K., 4,200-7,200 | 25.7 | .... |
| BAHRAIN | Awali, 1932 | 202 | 23 | 603 | 185 | Burgan, Miocene, 1,850-4,600 | 33.0 | .... |
| BRAZIL | Agua Grande, 1951 | 84 | 6 | 235 | 46 | Paleozoic, 3,281-6,562 | 38-42.0 | .... |
| | • Guaricema, 1968 | 12 | 2 | 10 | 96 | Paleozoic, 3,543 | 43.0 | .... |
| | Miranga, 1965 | 100 | 9 | 130 | 60 | Paleozoic, 3,281-6,542 | 29-41.0 | |
| BRUNEI | • Ampa, SW, 1963 | 82 | 34 | 371 | 751 | , 7,068-8,155 | 41.0 | |
| | • Champion, 1970 | 25 | 9 | 37 | 79 | , 4,300 | 23.0 | |
| | • Fairley, 1969 | 11 | 8 | 32 | 95 | , 10,740 | 40.0 | |
| | Seria, 1928 | 318 | 12 | 849 | 182 | , 10,450 | 34.0 | |
| BURMA | Chauk-Lanywa-Yenangyuang, 1902 | 490 | 8 | 173 | 31 | , 6,934 | 36.0 | |
| CABINDA | Malongo, N., 1966 | 52 | 13 | 274 | 1,005 | Cret., 8,750 | 23-35.0 | |
| | Malongo, W., 1969 | 38 | 33 | 134 | 900 | , 1,800-8,750 | 20.5-31.5 | |
| CANADA | Bonnie Glen, 1952 | 160 | 14 | 237 | 227 | D3, D1, 3,950-7,100 | 38.0-42.0 | 0.25 |
| | Fenn-Big Valley, 1960 | 288 | 4 | 157 | 111 | D2, D1, 5,300-5,400 | 26.0-32.0 | 0.71 |
| | Golden Spike, 1949 | 44 | 7 | 182 | 141 | D3. D1, 5,050-5,650 | 37.0 | 0.23 |
| Alberta | Judy Creek, 1959 | 215 | 18 | 213 | 325 | Beaverhill Lake, 8,650-8,850 | 41.0-42.0 | ... |
| | Kaybob, 1957 | 98 | 5 | 61 | 324 | Beaverhill Lake, 9,800 | 43.0 | 0.04 |
| | Leduc-Woodbend, 1947 | 801 | 7 | 337 | 263 | D2, D3, D., 4,200-5,450 | 40.0 | 0.30 |
| | Mitsue, 1964 | 238 | 17 | 123 | 239 | Gilwood, D. 5,650 | 43.0 | ... |
| | Pembina, 1953 | 3,238 | 35 | 875 | 910 | Cardium, K. 3,200-5,100 | 37.0-38.0 | 0.42 |
| | Rainbow Lake, 1965 | 137 | 24 | 213 | 108 | Keg River, 5,950-6,400 | 38.0-42.0 | ... |
| | Redwater, 1948 | 786 | 23 | 552 | 265 | D3, D., 3,200 | 36.0 | 0.42 |
| | Swan Hills, 1957 | 697 | 40 | 388 | 934 | Beaverhill Lake, 1,450-8,300 | 41.0-42.0 | 0.80 |
| | South Swan Hills, 1960 | 192 | 22 | 175 | 234 | Beaverhill Lake, 8,400 | 41.0 | 0.80 |
| | Turner Valley, 1913 | 170 | 1 | 125 | 48 | Rundle, Miss., 2,500-9,000 | 40.0 | 0.13 |
| | Wizard Lake, 1951 | 38 | 11 | 154 | 146 | Muskeg, D., 6,450 | 38.0 | |
| Saskatchewan | Steelman, 1954 | 580 | 7 | 181 | 32 | Midale, 4,590-4,620 | 38.0 | 1.89 |
| | Weyburn, 1955 | 520 | 10 | 200 | 112 | Midale, 4,600 | 28.0 | 2.12 |
| COLUMBIA | Casabe, 1941 | 279 | 2 | 201 | 23 | 3,880 | 20.8 | |
| | Infantas, 1918 | 305 | 1 | 211 | 18 | 3,200 | 25.8 | |
| | La Cira, 1925 | 594 | 6 | 419 | 35 | Miocene, 3,250 | 24.0 | 0.28 |
| | Orito, 1963 | 46 | 14 | 125 | 887 | Caballos, K., 6,600 | 39.7 | |
| | Palagua Velasquez, 1946 | 119 | 6 | 206 | 60 | , 4,925 | 19.0 | |
| | Provincia, 1962 | 26 | 5 | 107 | 55 | Cretaceous, 8,000 | 33.0 | |
| | Rio Zulia, 1962 | 17 | 4 | 111 | 74 | Mirador, Eo., 5,600 | 41.4 | |
| | Tibú, 1940 | 187 | 7 | 260 | 41 | Paleo., K., Eo., 4,200 | 37.2 | .... |
| CONGO | • Emeraude Marine, 1969 | 46 | 14 | 54 | 125 | , 1,000 | 23.0 | |
| DENMARK | • Dan, 1971 | 6 | 1 | 3 | 39 | , 6,000 | 30.4 | .... |
| DUBAI | • Fateh, 1966 | 27 | 54 | 301 | 1,303 | , 7,600-9,000 | 31.6 | |
| | • Fateh, S.Y., 1970 | 18 | 37 | 115 | 1,000 | , 7,500-9,000 | 32.5 | .... |

| Country | Field, disc. date | No. wells | Millions of bbl | | | Pay, ft | API gravity* | Sulfur wt % |
|---|---|---|---|---|---|---|---|---|
| | | | 1975 prod. | Cumulative production 1/1/76 | Estimated reserves 1/1/76 | | | |
| ECUADOR | Ancon, 1921 | 624 | .7 | 100 | 8 | , 4,000 | 35.6 | |
| | Lago Agrio, 1967 | 18 | 8 | 42 | 197 | Hollin, LK, 10,120 | 28.6 | |
| | Sacha, 1969 | 58 | 14 | 83 | 357 | Cretaceous, 9,900 | 29.7 | |
| | Shushufindi, 1969 | 39 | 22 | 83 | 378 | Cretaceous, 9,400 | 31.7 | |
| EGYPT | • Belayim, 1954 | | | 225 | 286 | Mio. Cret., 7,000-8,500 | 28.0 | |
| | • El Morgan, 1965 | 12 | 26 | 458 | 1,160 | Kareem, 5,100-6,400 | 32.0 | |
| FRANCE | Parentis, 1954 | 19 | 3 | 166 | 64 | Mesozoic, 7,550 | 33.0 | |
| GABON | Gamba, 1963 | 18 | 8 | 115 | 102 | , 3,000 | 32.4 | |
| INDONESIA | • Ardjuna, 1971 | 93 | 25 | 97 | 150 | Miocene, 5,000 | 36.8 | |
| | • Attaka, 1972 | 49 | 36 | 119 | 262 | Miocene, 7,500 | 41.1 | 0.1 |
| | Bangko, 1970 | 40 | 28 | 171 | 165 | Miocene, 1,500 | 34.1 | |
| | Bekasap, 1955 | 27 | 21 | 309 | 280 | Miocene, 2,500 | 33.4 | |
| | Benakat, 1932 | 67 | 1 | 125 | 10 | Miocene, 1,600 | 35.0 | |
| | Cinta, 1971 | 14 | 10 | 56 | 120 | Miocene, 4,500 | 34.0 | |
| | Duri, 1941 | 378 | 10 | 264 | 1,756 | Miocene, 600 | 21.3 | |
| | • Kitty, 1973 | 4 | .8 | 2 | 146 | Miocene, 4,000 | 18.2 | |
| | Limau, 1928 | 103 | 3 | 197 | 47 | Miocene, 4,950 | 27.8 | |
| | Melahin, 1975 | 5 | 1 | 1 | 50 | Miocene, 7,483 | 23.8 | |
| | Minas, 1944 | 222 | 130 | 2,027 | 5,270 | Miocene, 2,400 | 35.4 | |
| | Nora, 1974 | 5 | 1 | 2 | 75 | Miocene, 3,752 | 22.7 | |
| | Pematang, 1959 | 24 | 15 | 157 | 135 | Miocene, 2,800 | 31.7 | |
| | Petani, 1964 | 22 | 20 | 193 | 84 | Miocene, 4,700 | 32.7 | |
| | Rantau, 1929 | 220 | 8 | 208 | 87 | Miocene, 950-4,540 | 48.0 | |
| | Sago, 1940 | 81 | 2 | 109 | 38 | Miocene, 1,800 | 34.0 | |
| | Sanga-Sanga, 1893 | 99 | 1 | 237 | 12 | Miocene, 1,564 | 29.3 | |
| | Talang Akar, 1922 | 23 | .2 | 241 | 357 | Miocene, 2,800 | 35.0 | |
| | Talang Jimar, 1937 | 72 | 1 | 157 | 180 | Miocene, 4,200 | 27.8 | |
| | Tarakan, 1906 | 297 | 1 | 201 | 9 | Miocene, 3,943 | 21.6 | |
| IRAN | Agha Jari, 1936 | 50 | 292 | 6,201 | 3,843 | Asmari, 7,500 | 33.8 | 1.36 |
| | Ahwaz-Asmari, 1958 | 34 | 353 | 1,739 | 7,391 | Asmari, 8,700 | 31.9 | 1.66 |
| | • Bahregansar, 1960 | 7 | 6 | 104 | 194 | , 9,000-12,300 | 27.0 | |
| | Bibi Hakimeh, 1961 | 22 | 113 | 1,660 | 6,925 | Asmari, 5,400 | 29.7 | |
| | • Darius, 1961 | 12 | 32 | 375 | 976 | Yamama, 11,000 | 34.0 | |
| | Gach Saran, 1937 | 34 | 295 | 3,923 | 7,512 | Asmari, 9,000 | 31.1 | 1.66 |
| | Haft Kel, 1927 | 12 | 10 | 1,688 | 944 | Asmari, 2,100 | 38.4 | 1.12 |
| | Karanji, 1963 | 7 | 71 | 665 | 744 | Asmari, 7,000 | 34.2 | |
| | Marun, 1963 | 37 | 420 | 2,803 | 8,084 | Asmari, 11,000 | 32.9 | |
| | Masjid-e-Suleiman, 1908 | 38 | 4 | 1,356 | 1,514 | Asmari, 1,630 | 40.3 | |
| | Naft Safid, 1938 | 13 | 13 | 274 | 734 | Asmari, 5,000 | 36.5 | |
| | • Nowrouz, 1966 | 13 | 10 | 62 | 878 | Arab, C, 10,850 | 20.9 | |
| | Paris, 1964 | 9 | 47 | 757 | 2,377 | Asmari, 4,700 | 34.2 | |
| | Pazanan, 1961 | 7 | 9 | 154 | 3,367 | Asmari, 7,500 | 33.6 | |
| | Rag-e Safid, 1964 | 14 | 88 | 408 | 2,187 | Asmari, 7,500 | 28.5 | |
| | • Rostam, 1966 | 21 | 8 | 88 | 934 | Asmari, 9,800 | 33.7 | |
| | • Sassan, 1966 | 19 | 65 | 449 | 1,093 | Arab, D, 8,100 | 34.0 | |
| | Binak, 1959 | 1 | 17 | 128 | 100 | , 7,000 | 29.7 | |
| | Kharg, 1961 | 6 | 15 | 125 | 100 | , 6,000 | 32.4 | |
| IRAQ | Ain Zalah, 1939 | 2 | 2 | 162 | 54 | , 5,200-6,500 | 31.0 | |
| | Bai Hassan, 1953 | 12 | 12 | 248 | 966 | , 4,800-5,400 | 35.0 | |
| | Kirkuk, 1927 | 45 | 350 | 7,315 | 9,005 | Reef, 2,800-4,200 | 36.0 | 1.97 |
| | Naft Kaneh, 1909 | 2 | 4 | 116 | 36 | , 3,500 | 42.5 | |
| | Rumaila, 1953 | 30 | 292 | 2,430 | 11,405 | Zubair, 10,800 | 35.0 | |
| | Rumaila, N., 1958 | 30 | 55 | 180 | | Zubair, 10,500 | 34.0 | |
| | Zubair, 1948 | 33 | 73 | 776 | 3,566 | Zubair, 11,000 | 34.2 | |
| | Gela, 1956 | 68 | 4 | 92 | 250 | , 10,720 | 6.5-15.1 | |
| | Malossa, 1974 | 2 | .8 | .1 | | Hauptdolomite, 19,680 | 52.0 | |
| | Ragusa, 1954 | 27 | 2 | 107 | 96 | , 5,440 | 31.1-55.2 | |
| JAPAN | Kubiki, 1954 | 122 | | | 14 | , 1,099 | 31.0 | |
| KUWAIT | Ahmadi, 1953 | 78 | 690 | 16,982 | 54,552 | , 4,800 | | |
| | Bahrah, 1956 | 2 | | | | , 8,500 | | |
| | Burgan, 1938 | 374 | | | | Burgan, 4,800 | | |
| | Magwa, 1951 | 99 | | | | , 4,800 | | |
| | Minagish, 1959 | 14 | | | | Minagish, 10,000 | | |
| | Raudhatain, 1955 | 49 | | | | Zubair, 8,500 | | |
| | Sabriyah, 1957 | 45 | | | | , 8,000 | | |
| | Umm Gudair, 1962 | 31 | | | | , 9,300 | | |

| Country | Field, disc. date | No. wells | 1975 prod. (Millions of bbl) | Cumulative production 1/1/76 (Millions of bbl) | Estimated reserves 1/1/76 (Millions of bbl) | Pay, ft | API gravity* | Sulfur wt % |
|---|---|---|---|---|---|---|---|---|
| LIBYA | Bu Attifel, 1968 | 24 | 30 | 124 | 500 | ..........., 14,300 | 41.0 | ... |
| | Amal, 1959 | 81 | 19 | 512 | 3,725 | Cambro-Ord., 9,900 | 36.0 | . |
| | Bahi, 1968 | 31 | 6 | 179 | 154 | ........, 3,600-3,750 | 43.4 | |
| | Dahra, 1959 | 5 | 1 | 365 | 344 | Paleozoic, 3,100-3,700 | 41.0 | 0.29 |
| | Defa, 1969 | 60 | 42 | 387 | 191 | ........, 5,400-5,900 | 35.6 | |
| | Gialo, 1961 | 156 | 43 | 1,164 | 2,945 | Eocene, 2,200-6,300 | 35.7 | 0.52 |
| | Intisar "A", 1967 | 12 | 25 | 527 | 1,107 | "A", 9,750 | 45.0 | .... |
| | Intisar "D", 1967 | 18 | 50 | 575 | 703 | "D", 9,400 | 39.5 | .... |
| | Jebel, 1962 | 17 | 8 | 122 | 50 | ..........., 8,100 | 37.0 | .... |
| | Nafoora, 1965 | 28 | 18 | 542 | 740 | Precamb., Eo., 10,000 | 36.0 | .... |
| | Nasser, 1959 | 130 | 33 | 1,720 | 2,445 | Cret., 5,500-7,600 | 38.0 | 0.23 |
| | Raguba, 1961 | 40 | 16 | 426 | 611 | K. Camb. Ord., 5,400 | 43.0 | .... |
| | Sarir, 1961 | 68 | 64 | 889 | 7,445 | U. Cret., 9,000 | 37.2 | .... |
| | Waha, 1960 | 46 | 26 | 550 | 365 | Eo., K:, 6,600 | 36.1 | 0.24 |
| | Samah, 1961 | 10 | 13 | 247 | 100 | ..........., | 38.4 | .... |
| MALASIA | Bakau, 1971 | 2 | .... | .... | 10 | ..........., 11,000 | 39.0 | .... |
| | • Baram, 1967 | 29 | 14 | 73 | 148 | ..........., 9,500 | 40.5 | |
| | • Baronia, 1970 | 14 | 9 | 13 | 100 | ..........., 11,000 | 42.0 | .... |
| | Tembungo, 1973 | 3 | 1 | 1.3 | 55 | ..........., 6,000 | .... | .... |
| | • West Lutong, 1965 | 29 | 6 | 72 | 106 | ..........., 6,800 | 27.0 | .... |
| MEXICO | Magallanes, 1957 | 152 | 5 | 105 | 40 | ..........., 4,240 | 27.0 | .. |
| | Cinco Presidentes, 1960 | 114 | 8 | 206 | 52 | Cret., 6,862 | 35.0 | . |
| | Ebano-Panuco, 1901 | 488 | 3 | 934 | 370 | Cret., 1,450 | 12.0 | 5.38 |
| | El Plan, 1931 | 79 | 1 | 143 | 47 | Cret., 1,700 | 30.0 | .... |
| | Reforma, Chiapas-Tabasco, 1974 | .... | 100 | 100 | 5,700 | Cretaceous | .... | .... |
| | Naranjos Cerro Azul, 1909 | 53 | 2 | 1,157 | 19 | Cret., 1,800 | 20.0 | 3.80 |
| | | | | | | Tanabra, 7,090 | | |
| | Poza Rica, 1930 | 341 | 20 | 2,083 | 926 | Cret., 10,410 | 35.0 | 1.77 |
| | San Andres, 1956 | 139 | 11 | 264 | 78 | Cret., 10,410 | 29.0 | .... |
| NETHERLANDS | Schoonbeek, 1943 | 228 | 5 | 172 | 30 | Valanginian, 2,500 | 24.8 | .... |
| NEUTRAL ZONE | • Hout, 1969 | 26 | 15 | 139 | 485 | ..........., 5,500-11,300 | 34.0 | .... |
| | • Khafji, 1961 | 106 | 100 | 1,379 | 14,043 | "A", Bahrain, 4,300-12,000 | 28.4 | .... |
| | S. Umm Gudair, 1961 | 16 | 18 | 133 | 400 | ........, 8,800 | 24.0 | .... |
| Waira | Burgan, 1953 | 47 | 7 | 203 | 2,696 | Burgan Yamama, 3,600 | 24.0 | .... |
| | Eocene, 1954 | 213 | 15 | 372 | | Eocene, 2,200 | 18.5 | .... |
| | Ratawi, 1955 | 36 | 21 | 333 | | Ratawi, 7,000 | 24.3 | .... |
| NIGERIA | • Delta, 1966 | 17 | 12 | 64 | 175 | Tertiary 5,600 | 27.9 | .... |
| | • Delta, South, 1965 | 15 | 16 | 140 | 334 | Tertiary, 7,100-9,200 | 38.1 | .... |
| | Forc-Jones Creek, 1967 | 28 | 29 | 235 | 384 | Tertiary, 7,000-9,000 | 25.0 | .... |
| | Forc-Forc/Yokri, 1971 | 52 | 32 | 189 | 350 | Teritiary 10,859 | 25.0 | .... |
| | • Meren, 1965 | 41 | 27 | 248 | 309 | Tertiary 5,000-7,500 | 32.3 | .... |
| | • Okan, 1964 | 44 | 14 | 246 | 354 | Tertiary, 5,500-8,900 | 34.9 | .... |
| | Phl-Bomu, 1968 | 25 | 11 | 265 | 366 | Tertiary, 6,700-7,500 | 33.2 | .... |
| | Phl-Imo River, 1959 | 37 | 22 | 292 | 355 | Tertiary, 5,800-10,100 | 32.0 | .... |
| | Phl-Amuechem, 1959 | 12 | 5 | 108 | 95 | Tertiary, 5,800-10,700 | 37.6 | .... |
| | Phs.-Cawth. Channel, 1963 | 10 | 14 | 129 | 98 | Tertiary, 11,000 | 39.0 | .... |
| | Ugh-Kokori, 1961 | 19 | 18 | 206 | 155 | Tertiary, 8,000-9,800 | 44.0 | .... |
| | Ugh-Olomoro, 1963 | 22 | 10 | 185 | 175 | Tertiary, 7,000-10,000 | 22.3 | .... |
| NORWAY | • Cod, 1969 | ... | .... | .... | 48 | Paleocene, 9,750 | 50.0 | .. |
| | • Edda, 1972 | ... | .... | .... | 100 | Danian, 10,500 | 39.0 | .... |
| | • Eldfisk, 1970 | | .... | .... | 380 | ..........., 9,500 | 37.0 | .... |
| | • Ekofisk, 1970 | 24 | 46 | 104 | 1,416 | Danian, 10,000 | 37.0 | |
| | • Ekofisk West, 1970 | ... | .... | .... | 524 | Danian, 10,000 | 44.0 | |
| | • Statfjord, 1974 | 1 | .... | .. | 3,900 | Jurassic | 37.0 | .... |
| | • Tor, 1970 | ... | .... | ... | 150 | Danian, 10,000 | 39.0 | .... |
| | • Torfeld, 1970 | 3 | .... | .... | 128 | Danian, 10,000 | .... | .... |
| OMAN | Fahud-Naith, 1964 | 76 | 38 | 475 | 698 | Thamama, 2,000-6,080 | 32.7 | .. |
| | Natih-Natih, 1963 | 22 | 19 | 222 | 425 | L. Cret. 7,500 | 31.0 | .. |
| | Yibal-Shuaiba, 1962 | 65 | 34 | 165 | 500 | ..., 8,465 | 39.7 | .. |
| PERU | Concessiones Lima, 1905 | 954 | 9 | 178 | 247 | Tertiary, 2,000-9,000 | 35.0 | .... |
| | Talara, 1969 | 1,194 | 4 | 542 | 473 | Parinas, 2,000-9,000 | 40.0 | .... |
| QATAR | • Bul Hanine, 1970 | 6 | 53 | 198 | 352 | Arab, 6,000 | 35.0 | |
| | Dukhan, 1940 | 57 | 63 | 1,615 | 1,269 | Arab, Fadhili, 6,550 | 41.1 | |
| | • Idd El Shargi, 1960 | 14 | 6 | 156 | 1,962 | Arab, Fadhili, 8,250 | 35.0 | .. |
| | • Mayden-Mahzan, 1963 | 11 | 45 | 470 | 9,797 | Arab, Fadhili, 7,600 | 38.0 | .. |

| Country | Field, disc. date | No. wells | Millions of bbl |  |  | Pay, ft | API gravity* | Sulfur wt % |
|---|---|---|---|---|---|---|---|---|
|  |  |  | 1975 prod. | Cumulative production 1/1/76 | Estimated reserves 1/1/76 |  |  |  |
| SAUDI ARABIA | Abqaiq, 1940 | 60 | 278 | 5,226 | 7,252 | Arab, Jubaila, 6,670 | 38.0 | 1.30 |
|  | Abu Hadriyah, 1940 | 8 | 18 | 336 | 700 | Hadriyah, 9,930 | 35.0 | 1.20 |
|  | • Abu Sa'fah, 1963 | 14 | 22 | 322 | 6,297 | Arab, 6,650 | 30.0 | 2.70 |
|  | • Berri, 1964 | 45 | 122 | 965 | 5,121 | Arab, 7,450 | 33-38.0 | 2.40 |
|  | Dammam, 1938 | 18 | 7 | 548 | 4,774 | Arab, 4,620 | 34.0 | 1.54 |
|  | Fadhili, 1949 | 4 | 4 | 170 | 848 | Fadhili, 8,110 | 40.0 | 1.30 |
|  | Ghawar, 1948 | 391 | 1,535 | 13,192 | 63,240 | Arab, Jubaila, 6,700 | 35.0 | 1.80 |
|  | Khursaniyah, 1956 | 14 | 20 | 513 | 2,029 | Arab, 6,750 | 31.0 | 2.38 |
|  | • Manifah, 1957 | 2 | 13 | 143 | 870 | Arab, 7,950 | 28.0 | 3.00 |
|  | • Qatif, 1945 | 21 | 24 | 490 | 8,585 | Arab, 7,050 | 31.0 | 2.57 |
|  | • Safaniyah, 1951 | 92 | 302 | 3,515 | 11,927 | Cretaceous, 5,100 | 27.0 | 2.90 |
|  | • Zuluf, 1965 | 12 | 30 | 189 | 1,000 | , 5,800 | 32.0 | ... |
| SHARJAH | Mubarek, 1972 | 3 | 14 | 23 | 250 | , 12,650-990 | 37.4 |  |
| SPAIN | • Amposta, 1971 | 4 | 12 | 29 | 790 | , 10,000 | 37.0 |  |
| TRINIDAD | Brighton, 1908 | 143 | ... |  | 67 | , 700+ | 32.8 |  |
|  | Forest Reserve, 1913 | 456 | 3 | 239 | 269 | Forest, 500-11,000 | 23.0 |  |
|  | Fyzabad, 1918 | 232 | 1 | 153 | 351 | Miocene, 500-11,000 | 20.8-32.7 | ... |
|  | Galeota, 1972 | 15 | .2 | 1 | 10 | Miocene, 1,100+ | 31.6 |  |
|  | N. Marine, 1959 | 1 | ... | ... | 20 | , 3,000 | 23.2 |  |
|  | Soldado, 1955 | 233 | 18 | 300 | 239 | Miocene, 2,150-11,000 | 24.8 |  |
|  | Samaan, 1973 | 14 | ... | ... | 50 | , 8,719+ | 36.8 |  |
|  | Teak, 1972 | 28 | 20 | 62 | 100 | Miocene, 6,960+ | 29.3 |  |
| TUNISIA | • Ashtart, 1971 | 9 | 17 | 25 | 100 | , 9, 450 | 29.0 |  |
|  | El Borma, 1964 | 31 | 15 | 244 | 160 | , 8,250-8,900 | 42.0 |  |
| UNITED KINGDOM | • Brent, 1971 | ... | ... | ... | 2,250 | Jurassic, | ... |  |
|  | • Dunlin, 1973 | ... | ... | ... | 1,250 | Jurassic, |  | ... |
|  | • Forties, 1970 | ... | ... | ... | 1,800 | Paleocene, 7,000-8,000 |  |  |
|  | • Ninian, 1974 | ... | ... | ... | 1,000 | Jurassic, |  | 0.92 |
|  | • Piper | ... | ... | ... | ... | ... |  |  |
| UNITED STATES |  |  |  |  |  |  |  |  |
| Alabama | Citronelle, 1955 | 420 | 4 | 116 | 33 | Rodessa, 11,399 |  |  |
| Alaska | • Granite Point | 23 | 4 | 60 | 50 | Kenai, 8,772 |  |  |
|  | • McArthur River, 1965 | 57 | 41 | 294 | 208 | Kenai, 9,572 |  | ... |
|  | • Middle Ground Shoal | 35 | 8 | 96 | 89 | Kenai, 7,776 |  | ... |
|  | Prudhoe Bay, 1968 | 3 | 3 | 9 | 9,600 | Triassic, 8,210+ | ... | ... |
|  | Swanson River, 1957 | 41 | 9 | 163 | 60 | Hemlock, 11,150 | ... | ... |
| Appalachian | Alleghany, 1871 | - | .4 | 167 | 1 | Devonian, 1,500 | ... | ... |
|  | Bradford, 1871 | ... | 2 | 661 | 18 | Devonian, 1,500 | ... | ... |
| Arkansas | Magnolia | 56 | .5 | 154 | 7 | Cotton Valley, 6,390 | ... | ... |
|  | Schuler and East, 1937 | 109 | .6 | 106 | 4 | Cotton Valley, 5,580 | ... | ... |
|  | Smackover, 1922 | 2,631 | 3 | 512 | 18 | Smackover, 2,000 | ... | ... |
| California |  |  |  |  |  |  |  |  |
| San Joaquin Valley | Belridge, South, 1911 | 2,790 | 9 | 204 | 78 | Mio-Plio, 1,042 |  | ... |
|  | Buena Vista, 1910 | 1,134 | 3 | 621 | 31 | Pleist-Plio, 1,800 |  |  |
|  | Coalinga, 1887 | 2,188 | 6 | 639 | 60 | Several, 1,899 |  |  |
|  | Coalinga Nose, 1952 | 73 | 3 | 436 | 27 | Vaqueros, 6,445 |  |  |
|  | Coles Levee North, 1939 | 102 | 2 | 143 | 13 | Stevens, to 17,892 |  |  |
|  | Cuyama South, 1949 | 132 | 1 | 210 | 10 | Miocene, 2,128 |  |  |
|  | Cymric, 1916 | 752 | 3 | 134 | 23 | Many, 3,825 |  |  |
|  | Edison, 1934 | 570 | 1 | 115 | 11 | Many, 5,825 |  |  |
|  | Elk Hills, 1919 | 72 | .7 | 284 | 1,050 | Stevens, 2,300 |  |  |
|  | Fruitvale, 1957 | 356 | 1 | 103 | 10 | Chanac, 4,690 |  |  |
|  | Greeley, 1936 | 46 | .6 | 108 | 3 | Vedder, et al, 11,508 |  |  |
|  | Kern Front, 1925 | 1,039 | 4 | 139 | 32 | Etchegoin, 2,350 |  |  |
|  | Kern River, 1889 | 4,770 | 28 | 662 | 800 | Kern River, 913 |  |  |
|  | Kettleman North Dome, 1931 | 113 | .5 | 453 | 3 | Domengine, 8,292 |  |  |
|  | Lost Hills, 1910 | 1,207 | 2 | 121 | 20 | Etchegoin, 6,048 |  |  |
|  | McKittrick, 1887 | 993 | 6 | 212 | 47 | Multi, 9,144 |  |  |
|  | Midway Sunset | 6,325 | 37 | 1,265 | 380 | Tertiary, 1,740+ |  |  |
|  | Mount Poso, 1923 | 508 | 3 | 172 | 27 | Vedder, 2,616 |  |  |
|  | Rio Bravo, 1937 | 35 | .08 | 118 | .6 | Vedder, 11,611 |  |  |

| | | | Millions of bbl | | | | | |
|---|---|---|---|---|---|---|---|---|
| Country | Field, disc. date | No. wells | 1975 prod. | Cumulative production 1/1/76 | Estimated reserves 1/1/76 | Pay, ft | API gravity° | Sulfur wt % |
| Coastal Area | Cat Canyon†, 1908 | 627 | 6 | 180 | 42 | Sisquoc, 6,000 | .... | .... |
| | • Dos Cuadras, 1969 | 123 | 14 | 116 | 79 | Pliocene, 3,673 | .... | .... |
| | Elwood, 1928 | 11 | .03 | 103 | .4 | Multi, 5,620 | .... | .... |
| | Orcutt, 1902 | 179 | 1 | 150 | 10 | Monterey, 2,700 | .... | .... |
| | Rincon, 1927 | 304 | 3 | 126 | 25 | Pico, 11,750 | .... | .... |
| | San Ardo, 1947 | 920 | 14 | 288 | 120 | Monterey, 2,150 | .... | .... |
| | • Santa Ynez‡, 1934 | .... | .... | .... | .... | Miocene, 10,000 | .... | .... |
| | Santa Maria Valley, 1934 | 237 | 3 | 162 | 27 | Monterey, 5,738 | .... | .... |
| | South Mountain | 435 | 1 | 132 | 15 | Pico, 7,211 | .... | .... |
| | Ventura, 1916 | 799 | 11 | 805 | 97 | Repetto, 3,400 | .... | .... |
| Los Angelas Basin | Beverly Hills, 1967 | 124 | 4 | 83 | 28 | Pliocene, 3,387+ | .... | .... |
| | Brea Olinda, 1884 | 725 | 3 | 347 | 31 | Miocene, 2,698 | .... | .... |
| | Coyote East, 1917 | 188 | .6 | 99 | 5 | Repetto, 3,318+ | .... | .... |
| | Coyote West, 1909 | 141 | 2 | 234 | 15 | Repetto, 4,045 | .... | .... |
| | Dominguez, 1923 | 131 | 1 | 259 | 8 | Pliocene, 3,800 | .... | .... |
| | • Huntington Beach, 1920 | 1,097 | 17 | 941 | 125 | Mio-Plio, 2,100 | .... | .... |
| | Inglewood, 1924 | 441 | 3 | 300 | 21 | Many, 2,200 | .... | .... |
| | Long Beach, 1921 | 605 | 3 | 881 | 26 | Mio-Plio, 4,400 | .... | .... |
| | Montebello, 1917 | 194 | .6 | 185 | 4 | Repetto, 7,650 | .... | .... |
| | Richfield, 1919 | 295 | 2 | 166 | 14 | Puente, 3,800 | .... | .... |
| | Santa Fe Springs, 1919 | 204 | .7 | 601 | 9 | Buckbee, 2,117 | .... | .... |
| | Seal Beach, 1924 | 168 | 1 | 189 | 9 | Repetto, 8,600 | .... | .... |
| | Torrance, 1922 | 389 | 3 | 185 | 24 | Repetto, 4,400 | .... | .... |
| | • Wilmington, 1932 | 2,249 | 66 | 1,747 | 632 | Mio-Plio, 1,200 | .... | .... |
| Colorado | Rangely | 324 | 19 | 533 | 179 | Weber, 6,200 | .... | .... |
| Florida | Jay, 1970 | 86 | 34 | 109 | 234 | Smackover, 15,500 | .... | .... |
| Illinois | Clay City | 2,150 | 3 | 311 | 14 | Miss., 2,100 | .... | .... |
| | Dale | 480 | .3 | 101 | 4 | Miss., 2,500 | .... | .... |
| | Lawrence | 2,720 | 3 | 365 | 1 | Miss., 2,100 | .... | .... |
| | Loudon, 1938 | 1,200 | 2 | 366 | 19 | Miss., 1,000 | .... | .... |
| | Main | 3,000 | .9 | 225 | 11 | Miss., 1,500 | .... | .... |
| | New Harmony, 1939 | 1,000 | 1 | 157 | 13 | Miss., 717-3,755 | .... | .... |
| | Salem, 1939 | 1,295 | 3 | 358 | 11 | Miss., 1,700 | .... | .... |
| Kansas | Bemis-Shutts, 1935 | 893 | 2 | 220 | 15 | Lansing, 3,408 | .... | .... |
| | Chase-Silica, 1931 | 1,010 | 1 | 251 | 8 | Arbuckle, 3,383 | .... | .... |
| | Eldorado, 1915 | 710 | 1 | 281 | 9 | Several, 630 | .... | .... |
| | Hall-Gurney, 1931 | 1,147 | 2 | 129 | 11 | Tarkio, 2,340 | .... | .... |
| | Kraft-Prusa, 1937 | 585 | .8 | 119 | 7 | Many, 3,340 | .... | .... |
| | Trapp, 1936 | 908 | 1 | 208 | 14 | Many, 2,359 | .... | .... |
| Louisiana Onshore | Avery Island, 1942 | 29 | .8 | 80 | 30 | Miocene, 9,550 | .... | .... |
| | Bay de Chene, 1941 | 81 | 5 | 80 | 47 | Miocene, 2,460 | .... | .... |
| | Bay St. Elaine, 1937 | 88 | 4 | 147 | 53 | Miocene, 5,700 | .... | .... |
| | Bayou Sale, 1940 | 62 | 3 | 148 | 27 | Many, 4,500 | .... | .... |
| | Black Bay West, 1953 | 135 | 6 | 98 | 52 | Miocene, 9,600 | .... | .... |
| | Caillou Island, 1930 | 333 | 14 | 531 | 191 | Miocene, 3,640 | .... | .... |
| | Cote Blanche Island, 1948 | 29 | 4 | 83 | 47 | Miocene, 7,206 | .... | .... |
| | Delta Farms, 1940 | 39 | .7 | 111 | 9 | Miocene, 10,347 | .... | .... |
| | Garden Island Bay, 1934 | 265 | 7 | 182 | 74 | Miocene, 9,000 | .... | .... |
| | Gibson, 1937 | 80 | 2,000 | 906 | 1,094 | Miocene, 8,594 | 32.0 | .... |
| | Golden Meadow, 1938 | 211 | 2 | 118 | 17 | Miocene, 10,234 | .... | .... |
| | Grand Bay, 1938 | 148 | 3 | 156 | 49 | Multi, 5,000 | .... | .... |
| | Hackberry East, 1927 | 76 | 1 | 95 | 15 | Miocene, 2,590+ | .... | .... |
| | Hackberry West, 1928 | 136 | 2 | 120 | 20 | Miocene, 2,950+ | .... | .... |
| | Iowa, 1931 | 32 | 1 | 93 | 7 | Miocene, 4,390 | .... | .... |
| | Jennings, 1901 | 73 | .2 | 112 | 3 | Pliocene, 1,300+ | .... | .... |
| | Lafitte, 1935 | 231 | 5 | 218 | 66 | Miocene, 4,200 | .... | .... |
| | Lake Barre, 1929 | 98 | 3 | 174 | 46 | Miocene, 3,400+ | 31.0 | .... |
| | Lake Pelto, 1929 | 71 | 3 | 104 | 31 | Miocene, 4,176+ | .... | .... |
| | Lake Salvador, 1940 | 62 | 1 | 77 | 33 | Miocene, 4,819+ | .... | .... |
| | Lake Washington, 1931 | 137 | 5 | 204 | 71 | Miocene, 1,140+ | .... | .... |
| | Leeville, 1931 | 85 | 3 | 128 | 21 | Miocene, 6,040+ | .... | .... |
| | Paradis, 1939 | 79 | 5 | 108 | 21 | Miocene, 9,620 | 51.0 | .... |
| | Quarantine Bay, 1937 | 118 | 3 | 153 | 32 | Miocene, 6,124 | .... | .... |
| | Romere Pass, 1950 | 33 | 2 | 82 | 23 | Miocene, 6,466 | .... | .... |
| | Timbalier Bay | 350 | 6 | 240 | 186 | Miocene, 3,556+ | .... | .... |
| | Venice, 1937 | 111 | 4 | 162 | 43 | Miocene, 2,345 | .... | .... |
| | Vinton, 1910 | 201 | 3 | 126 | 14 | Miocene, 1,550+ | .... | .... |
| | Weeks Island, 1945 | 77 | 5 | 205 | 85 | Miocene, 18,000 | .... | .... |
| | West Bay, 1940 | 208 | 6 | 182 | 58 | Miocene, 5,900 | .... | .... |
| | W. Cote Blanche Bay | 365 | 8 | 155 | 95 | Miocene, 2,035 | .... | .... |

†Combines Cat Canyon West and Cat Canyon East.
‡Undeveloped fields, Santa Barbara Channel, uncorroborated reserves—1 bil bbl.

|  |  |  | Millions of bbl |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|
| Country | Field, disc. date | No. wells | 1975 prod. | Cumulative production 1/1/76 | Estimated reserves 1/1/76 | Pay, ft | API gravity* | Sulfur wt % |
| Louisiana, North | Caddo Pine Island, 1905 | 6,954 | 3 | 316 | 24 | Cretaceous, 767 |  |  |
|  | Delhi, 1944 | 112 | 7 | 173 | 95 | Many, 3,000 |  |  |
|  | Haynesville (Ark. La.), 1921 | 186 | 2 | 173 | 11 | Potter Smk., 2,700+ |  |  |
|  | Homer | 165 | .3 | 92 | 8 | Cotton Valley, 1,100+ |  |  |
|  | Rodessa (La., Tex.), 1935 | 140 | .3 | 176 | 4 | Hill, 5,300 |  |  |
| Louisiana Offshore | • Bay Marchand Blk 2, (Incl. onshore), 1949 | 195 | 22 | 452 | 198 | Many, 2,472+ |  |  |
|  | • Eugene Island, Blk 126, 1950 | 50 | 4 | 93 | 32 | Miocene, 4,000+ |  |  |
|  | • Eugene Island Blk 330 | 136 | 28 | 68 | 162 | Miocene, 6,953 |  |  |
|  | • Eugene Island, Blk 175 | 60 | 5 | 42 | 78 | Miocene, 9,458+ |  |  |
|  | • Eugene Island, Blk 276 | 60 | 4 | 51 | 114 | Pliocene, 6,083+ |  |  |
|  | • Grand Isle Blk. 16, 1948 | 77 | 11 | 222 | 127 | Miocene, 1,539+ |  |  |
|  | • Grand Isle Blk. 43, 1956 | 220 | 17 | 181 | 189 | Miocene, 2,325+ |  |  |
|  | • Grand Isle Blk 47, 1955 | 65 | 3 | 68 | 32 | Miocene, 4,096+ |  |  |
|  | • Main Pass Blk 35, 1951 | 66 | 1 | 81 | 19 | Miocene, 6,000 |  |  |
|  | • Main Pass, Blk. 41, 1957 | 97 | 9 | 154 | 126 | Miocene, 3,470+ |  |  |
|  | • Main Pass Blk. 69, 1948 | 117 | 6 | 196 | 63 | Miocene, 5,500 |  |  |
|  | • Main Pass Blk. 306 | 124 | 5 | 37 | 113 | Miocene, 6,167 |  |  |
|  | • Ship Shoal Blk. 204 | 48 | 4 | 31 | 73 | Miocene, 9,832+ |  |  |
|  | • Ship Shoal Blk. 207 | 49 | 5 | 49 | 125 | Miocene, 11,814+ |  |  |
|  | • Ship Shoal Blk. 278, 1962 | 73 | 8 | 101 | 124 | Miocene, 9,859+ | 75.0 |  |
|  | • South Marsh Island Blk 73 | 41 | 3 | 44 | 60 | Miocene, 6,780+ |  |  |
|  | • South Pass Blk 24 (incl. onshore) | 434 | 13 | 384 | 106 | Miocene, 6,520 |  |  |
|  | • South Pass Blk 27, 1954 | 327 | 9 | 268 | 116 | Miocene, 6,542 |  |  |
|  | • South Pass Blk. 62 | 61 | 5 | 54 | 136 | Miocene, 5,392+ |  |  |
|  | • South Pass Blk 65 | 65 | 8 | 55 | 136 | Miocene, 8,033+ |  |  |
|  | • Timbalier Bay Blk 21 | 169 | 6 | 165 | 95 | Miocene, 3,556 |  |  |
|  | • West Delta Blk 30, 1949 | 194 | 18 | 330 | 120 | Miocene, 2,152+ |  |  |
|  | • West Delta Blk 58 | 70 | 9 | 47 | 153 | Miocene, 11,668+ |  |  |
|  | • West Delta Blk 73, 1962 | 112 | 8 | 136 | 138 | Miocene, 8,328+ |  |  |
| Mississippi | Baxterville, 1944 | 197 | 6 | 173 | 62 | Tusc., Wx., 3,158+ |  |  |
|  | Heidelberg, 1944 | 263 | 5 | 120 | 30 | Many, 4,722+ |  |  |
|  | Tinsley, 1939 | 180 | 2 | 198 | 21 | Smack., Tusc., 4,400+ |  |  |
| Montana | Bell Creek, 1967 | 241 | 8 | 77 | 39 | Muddy, 4,800 |  |  |
|  | Cut Bank, 1962 | 1,000 | 4 | 142 | 55 | Cut Bank, 2,600 |  |  |
|  | Pine, 1951 | 109 | 3 | 81 | 19 | Ord-Sil., 8,618+ |  |  |
| New Mexico | Caprock and East, 1940 | 357 | .4 | 93 | 7 | Multi, 2,800+ |  |  |
|  | Denton | 185 | 1 | 126 | 14 | Multi, 9,488+ |  |  |
|  | Empire Abo, 1957 | 263 | 15 | 126 | 74 | Abo, 6,014 |  |  |
|  | Eunice, 1929 | 1,089 | 4 | 130 | 58 | Many, 3,530 |  |  |
|  | Hobbs, 1928 | 414 | 4 | 226 | 45 | San Andres, 4,050 |  |  |
|  | Maljamar, 1926 | 802 | 5 | 109 | 56 | Grayburg, 3,600 |  |  |
|  | Monument, 1948 | 109 | .3 | 211 | 29 | Many, 5,180 |  |  |
|  | Vacuum, 1929 | 956 | 12 | 287 | 112 | Cretaceous, Paleoz., 3,000 |  |  |
| North Dakota | Beaver Lodge, 1951 | 138 | 3 | 81 | 40 | Paleoz., 8,550+ |  |  |
|  | Tioga, 1952 | 118 | 1 | 58 | 28 | Paleoz., 7,990+ |  |  |
| Oklahoma | Allen, 1913 | 1,495 | 2 | 129 | 11 | Multi, 1,100+ |  |  |
|  | Avant, 1904 | 650 | .3 | 107 | 2 | Bartlesville, 1,400 |  |  |
|  | Bowlegs, 1927 | 160 | 1 | 160 | 16 | Multi, 2,950+ |  |  |
|  | Burbank, 1920 | 1,050 | 3 | 507 | 33 | Multi, 2,700+ |  |  |
|  | Cement, 1917 | 1,430 | 2 | 143 | 12 | Multi, 1,900+ |  |  |
|  | Cushing, 1912 | 1,665 | 3 | 466 | 19 | Multi, 1,475 |  |  |
|  | Earlsboro, 1960 | 205 | .5 | 217 | 3 | Multi, 2,960 |  |  |
|  | Edmond West, 1943 | 435 | .5 | 156 | 4 | Hunton, 6,938 |  |  |
|  | Eola-Robberson, 1921 | 480 | 3 | 111 | 29 | Multi, 1,300+ |  |  |
|  | Fitts, 1932 | 635 | 3 | 153 | 19 | Multi, 1,150+ |  |  |
|  | Glenn Pool, 1905 | 1,055 | 2 | 311 | 19 | Multi, 815+ |  |  |
|  | Golden Trend, 1945 | 1,115 | 6 | 408 | 92 | Multi, 6,210+ |  |  |
|  | Healdton, 1913 | 1,440 | 7 | 301 | 52 | Multi, 920+ |  |  |
|  | Hewitt, 1919 | 1,155 | 5 | 224 | 45 | Multi, 900+ |  |  |
|  | Little River, 1937 | 165 | .3 | 160 | 5 | Multi, 2,280+ |  |  |
|  | Oklahoma City, 1928 | 250 | 2 | 736 | 16 | Multi, 6,700+ |  |  |
|  | Postle | 285 | 5 | 76 | 55 | Morrow, 6,039+ |  |  |
|  | Seminole Greater, 1926 | 225 | .9 | 200 | 10 | Multi, 2,289+ |  |  |
|  | Sho-Vel-Tum, 1955 | 8,060 | 33 | 1,035 | 265 | Multi, 1,890+ |  |  |
|  | Sooner Trend, 1965 | 3,075 | 9 | 208 | 55 | Multi, 5,000+ |  |  |
|  | St. Louis, 1925 | 585 | 1 | 217 | 8 | Multi, 3,093+ |  |  |
|  | Tonkawa, 1921 | 205 | .3 | 135 | 1 | Multi, 2,600+ |  |  |

| Country | Field, disc. date | No. wells | 1975 prod. (Millions of bbl) | Cumulative production 1/1/76 (Millions of bbl) | Estimated reserves 1/1/76 (Millions of bbl) | Pay, ft | API gravity° | Sulfur wt % |
|---|---|---|---|---|---|---|---|---|
| Texas | | | | | | | | |
| Dist. 1 | Darst Creek, 1929 | 875 | 1 | 143 | 17 | Austin, 2,240+ | | |
| | Luling-Branyon, 1922 | 1,421 | 1 | 148 | 12 | Austin, 1,600+ | | |
| Dist. 2 | Greta All, 1933 | 192 | 4 | 121 | 38 | Mio., Olig., 1,700+ | | |
| | Lake Pasture, | 209 | 4 | 70 | 57 | Frio., 5,900+ | | |
| | Refugia All, 1921 | 68 | .2 | 95 | 4 | Frio., 2,800+ | .... | .... |
| | Tom O'Connor, 1934 | 935 | 25 | 521 | 179 | Frio., 1,720+ | .... | .... |
| | West Ranch, 1938 | 608 | 14 | 285 | 83 | Frio., 3,440 | | .... |
| Dist. 3 | Anahauc, 1935 | 234 | 7 | 256 | 99 | Frio., 2,990 | .... | .... |
| | Barbers Hill, 1918 | 102 | .4 | 125 | 10 | Marg., 1,000+ | .... | .... |
| | Conroe, 1931 | 584 | 21 | 562 | 175 | Tertiary, 2,000 | .... | .... |
| | Dickinson-Gillock, 1934 | 69 | 2 | 109 | 40 | Frio., 7,786 | .... | .... |
| | Goose Creek & East, 1908 | 215 | .7 | 131 | 8 | Frio., Mio., 1,000+ | .... | .... |
| | Hastings E&W, 1934 | 403 | 28 | 531 | 225 | Frio., Mio., 5,500 | .... | .... |
| | High Island, All, 1922 | 99 | .9 | 132 | 18 | Tertiary, 2,342+ | .... | .... |
| | Hull-Merchant, 1918 | 387 | 1 | 195 | 10 | Yegua, 400 | .... | .... |
| | Humble All, 1905 | 413 | 1 | 163 | 27 | Tertiary, 700+ | .... | .... |
| | Magnet Withers All, 1936 | 285 | 2 | 83 | 42 | Frio., 838+ | .... | .... |
| | Old Ocean, 1934 | 18 | .4 | 122 | 9 | Frio., 8,600 | .... | .... |
| | Oyster Bayou | 38 | 5 | 100 | 46 | Frio., 7,580 | .... | .... |
| | Raccoon Bend, 1928 | 136 | 2 | 94 | 31 | Miocene, 900+ | .... | .... |
| | Sour Lake, 1902 | 386 | .9 | 118 | 7 | Caprock, 700+ | .... | .... |
| | Spindletop, 1901 | 76 | .1 | 154 | 3 | Tertiary, 800+ | .... | .... |
| | Thompson All, 1931 | 291 | 15 | 385 | 115 | Frio., Mio., 2,400 | .... | .... |
| | Tomball | 209 | 2 | 106 | 30 | Oligocene, 6,500 | .... | .... |
| | Webster, 1937 | 141 | 25 | 438 | 201 | Frio., Vick., 4,170 | .... | .... |
| | West Columbia, 1915 | 181 | 1 | 158 | 12 | Tertiary, 600+ | .... | .... |
| Dist. 4 | Agua Dulce-Stratton, 1928 | 226 | 2 | 140 | 30 | Frio., 2,000 | .... | .... |
| | Borregas All, 1945 | 232 | 1 | 109 | 26 | Frio., 4,000+ | .... | .... |
| | Kelsey All, 1938 | 313 | 2 | 109 | 41 | Frio., 4,690+ | .... | .... |
| | Plymouth, 1935 | 94 | .7 | 117 | 7 | Frio., 3,400+ | .... | .... |
| | Seeligson All, 1937 | 419 | 2 | 265 | 60 | Frio., 4,880+ | .... | .... |
| | Tijerina-Canales-Bulcher, 1944 | 55 | .6 | 101 | 64 | Frio., 6,000+ | .... | .... |
| | Zone 21-13 | 151 | 1 | ... | ... | | | |
| | White Point East, 1938 | 139 | .7 | 100 | 10 | Frio., 3,100+ | .... | .... |
| Dist. 5 | Mexia, 1920 | 106 | .1 | 107 | 2 | Cret., J., 3,065+ | .... | .... |
| | Powell, 1895 | 45 | .09 | 130 | .8 | Woodbine, 3,000 | .... | .... |
| | Van and Van Shallow, 1929 | 426 | 16 | 435 | 115 | Woodbine, 1,200 | .... | .... |
| Dist. 6 | East Texas, 1930 | 12,958 | 69 | 4,310 | 1,690 | Woodbine, 3,600 | .... | .... |
| | Fairway, 1960 | 94 | 11 | 135 | 78 | Pettet, 9,800 | .... | .... |
| | Hawkins, 1940 | 365 | 41 | 576 | 248 | Woodbine, 4,100 | .... | .... |
| | Neches, 1953 | 164 | 4 | 65 | 57 | Cretaceous, 4,572 | .... | .... |
| | Quitman All, 1942 | 259 | 3 | 84 | 26 | Many, 3,980+ | .... | .... |
| | Talco, 1936 | 609 | 3 | 241 | 50 | Paluxy, 4,300 | .... | .... |
| Dist. 7-B | Eastland County, 1917 | 225 | .2 | 121 | 12 | Paleozoic, 1,200+ | .... | .... |
| | Stephens County, 1915 | 549 | 2 | 171 | 16 | Paleozoic, 1,800+ | .... | .... |
| Dist. 7-C | Big Lake, 1923 | 117 | .5 | 125 | 10 | Many, 2,400+ | .... | .... |
| | McCamey, 1925 | 881 | .8 | 125 | 5 | Many, 2,000+ | .... | .... |
| | Pegasus, 1949 | 173 | 2 | 115 | 25 | Many, 12,700 | .... | .... |
| Dist. 8 | Andector, 1947 | 103 | 6 | 134 | 51 | Many, 4,220 | .... | .... |
| | Block 31, 1948 | 123 | 6 | 150 | 40 | Many, 2,962 | .... | .... |
| | Cowden North, 1930 | 1,102 | 16 | 293 | 148 | Many, 3,999 | .... | .... |
| | Cowden South, Foster, Johnson | 1,290 | 16 | 316 | 84 | Many, 4,030 | .... | .... |
| | Dollarhide, 1945 | 138 | 5 | 155 | 55 | Ellen O., 6,500+ | .... | .... |
| | Dune, 1938 | 971 | 6 | 132 | 67 | Many, 3,130+ | .... | .... |
| | Emma and Triple N., 1937 | 207 | 1 | 98 | 17 | Many, 4,000+ | .... | .... |
| | Fullerton, 1942 | 581 | 7 | 245 | 146 | Many, 4,400+ | .... | .... |
| | Goldsmith All, 1934 | 2,620 | 16 | 595 | 80 | Many, 4,100 | .... | .... |
| | Hendrick, 1926 | 200 | .6 | 253 | 2 | Yates, Atoka, 2,400 | .... | .... |
| | Howard Glasscock, 1925 | 1,898 | 7 | 317 | 74 | Many, 1,276 | .... | .... |
| | Iatan East, 1926 | 891 | 4 | 90 | 35 | Clearfork, 2,600 | .... | .... |
| | Jordan, 1937 | 330 | 3 | 106 | 24 | Many, 3,650+ | .... | .... |
| | KeKrmit, 1928 | 464 | .8 | 113 | 17 | Many, 2,700 | .... | .... |
| | Keystone, 1930 | 737 | 4 | 276 | 43 | Many, 2,950 | .... | .... |
| | McElroy, 1926 | 2,056 | 12 | 322 | 88 | Many, 2,700 | .... | .... |
| | Means All, 1934 | 378 | 6 | 152 | 58 | Many, 2,950 | .... | .... |
| | Midland Farms All, 1944 | 333 | 6 | 182 | 74 | Many, 4,600 | .... | .... |
| | Penwell, 1946 | 455 | 1 | 86 | 14 | Many, 3,600+ | .... | .... |
| | Sand Hills, 1930 | 1,034 | 4 | 194 | 51 | Many, 3,000+ | .... | .... |
| | Shafter Lake, 1938 | 425 | 2 | 74 | 26 | Many, 2,800+ | .... | .... |
| | TXL All, 1944 | 678 | 3 | 240 | 25 | Many, 4,525 | .... | .... |
| | Waddell, 1927 | 280 | 2 | 84 | 26 | Many, 3,500 | .... | .... |
| | Ward South, 1937 | 448 | .6 | 97 | 3 | Many, 2,500 | .... | .... |
| | Ward Estes North, 1929 | 1,278 | 5 | 316 | 59 | Yates, 2,800 | .... | .... |
| | Yates, 1926 | 586 | 18 | 623 | 976 | Grayburg, 1,150 | .... | .... |
| Dist. 8-A | Anton Irish, 1944 | 188 | 7 | 81 | 34 | Clearfork, 5,348 | .... | .... |
| | Anton, 1944 | 3 | .01 | 78 | 32 | Clearfork, 5,348 | .... | .... |
| | Cogdell Area, 1949 | 386 | 13 | 201 | 120 | Many, 6,796 | .... | |

| Country | Field, disc. date | No. wells | 1975 prod. | Millions of bbl— Cumulative production 1/1/76 | Estimated reserves 1/1/76 | Pay, ft | API gravity* | Sulfur wt % |
|---|---|---|---|---|---|---|---|---|
|  | Diamond M, 1948 | 469 | 7 | 204 | 71 | Many, 2,430 |  |  |
|  | Kelly-Snyder, 1948 | 803 | 73 | 832 | 517 | Many, 3,320 |  |  |
|  | Levelland, 1938 | 1,638 | 14 | 246 | 109 | Many, 6,984 |  |  |
|  | Prentice, 1951 | 299 | 6 | 100 | 40 | Many, 5,940+ |  | .... |
|  | Russell All, 1943 | 198 | 2 | 114 | 21 | Many, 4,800+ |  | .... |
|  | Salt Creek, 1958 | 120 | 12 | 138 | 92 | Penn., 6,400 |  | .... |
|  | Seminole All, 1936 | 408 | 24 | 243 | 72 | Many, 3,170 |  | .... |
|  | Slaughter, 1936 | 2,771 | 46 | 642 | 116 | San Andres, 4,950 |  | .... |
|  | Spraberry Trend, 1953 | 4,219 | 19 | 398 | 112 | Spraberry, 6,100 |  | .... |
|  | Wasson All, 1936 | 2,167 | 94 | 973 | 536 | Many, 4,890 |  | .... |
|  | Welch | 405 | 5 | 94 | 56 | San Andres, 4,918 |  | .... |
| Dist. 9 | Archer County, 1911 | 3,118 | 2 | 241 | 18 | Cisco, 450+ | .... | .... |
|  | Cooke County, 1924 | 1,684 | 1 | 96 | 17 | Cisco, 700+ | .... | .... |
|  | KMA, 1931 | 881 | 2 | 169 | 16 | Strawn, 3,700 | .... | .... |
|  | Walnut Bend, 1938 | 276 | 3 | 104 | 35 | Many, 1,400+ | .... | .... |
|  | Wichita County, 1911 | 5,939 | 4 | 509 | 37 | Cisco, 500+ | .... | .... |
|  | Wilbarger County, 1915 | 1,509 | 1 | 161 | 20 | Cisco, 1,198+ |  | .... |
|  | Young County, 1917 | 1,896 | 1 | 144 | 18 | Caddo, 550+ | .... | .... |
| Dist. 10 | Panhandle, 1910 | 10,175 | 11 | 1,295 | 120 | Permian, 3,140 | .... | .... |
| Utah | Altamont | 223 | 22 | 68 | 206 | Green River, 12,910 |  | .... |
|  | Greater Aneth, 1956 | 403 | 8 | 268 | 48 | Hermosa, 5,600 | .... | .... |
|  | Greater Red Wash, 1951 | 215 | 4 | 95 | 42 | Green River, 5,400 |  | .... |
|  | Brady, 1975 | 27 | .06 | 2 | 100 | Weber, 14,000 | .... | .... |
| Wyoming | Elk Basin (Wyo.-Mont.), 1915 | 261 | 9 | 457 | 61 | Frontier, 1,684 | .... | .... |
|  | Garland, 1906 | 123 | 4 | 116 | 22 | Many, 4,000 | .... | .... |
|  | Grass Creek, 1914 | 227 | 3 | 143 | 21 | Frontier, 3,600+ | .... | .... |
|  | Hamilton Dome, 1918 | 239 | 4 | 222 | 31 | Ord. Tria., 2,000 | .... | .... |
|  | Hilight, 1969 | 195 | 8 | 56 | 78 | Muddy, 9,578 | .... | .... |
|  | Lance Creek, 1918 | 35 | .2 | 105 | 2 | Frontier, 2,689 | .... | .... |
|  | Lost Soldier, 1916 | 63 | 4 | 160 | 40 | Many, 191+ | .... | .... |
|  | Oregon Basin, 1912 | 295 | 11 | 252 | 88 | Many, 1,325 | .... | .... |
|  | Salt Creek, 1906 | 1,024 | 15 | 557 | 67 | Many, 370+ | .... | .... |
| U.S.S.R. |  |  |  |  |  |  |  |  |
|  | Arlan, 1955 | 2,000 | 110 | 1,900 | 2,685 | Carb., 4,429 | 27.2 | 3.04 |
|  | Baku Archipelago, 1963 | 120 | 34 | 181 | 679 | Plio., 8,773 | 28 | 0.25 |
|  | Fedorovskoye, 1971 | 200 | 30 | 46 | 976 | LK |  | .... |
|  | Kotur-Tepe, 1956 | 350 | 70 | 720 | 740 | Plio., 8,793 | 29-44 | 0.2 |
|  | Kuleshova, 1958 | 300 | 40 | .. | 460 | Paleoz. 10,860 | 41 | 0.70 |
|  | Malgobek-Voznesensko-Aliyurt, 1915 | ... | 55 | 2,370 | 600 | K, Mio. 10,200 | 34 | 0.20 |
|  | Mamontovo, 1965 | 450 | 70 | 330 | 1,422 | K, 6,300 | 27 | 1.51 |
|  | Megion, 1961 | 230 | 35 | 235 | 495 | Jur., K, 8,235 | 34 | 0.86 |
|  | Mukhanovo, 1945 | 600 | 55 | 1,055 | 445 | Paleo., 10,007 | 38 | 1.0 |
|  | Neftiane Kamni, 1949 | 1,200 | 26 | 851 | 374 | Plio., 5,406 | 25 | 0.2 |
|  | Novo-Elkhovskoye, 1951 | 1,000 | 60 | 1,960 | 1,040 | Paleoz., 5,577 | 32 | 1.2 |
|  | Pravdinsk, 1964 | 325 | 49 | 203 | 994 | LK, 9,580 | 35 | 0.7 |
|  | Romashkino, 1948 | 5,000 | 310 | 10,170 | 3,830 | Dev., 5,791 | 31.7 | 1.62 |
|  | Samotlorskoye, 1965 | 1,200 | 635 | 1,700 | 12,900 | LK, 7,316 | 35 | 0.76 |
|  | Salym, 1963 | 10 | 1 | 1 | 9,999 | K, 7,200 | 33 | 0.2 |
|  | Shkapovo, 1953 | 700 | 40 | 1,140 | 500 | Paleoz., | 30.5 | 1.6 |
|  | Sovetskoye, 1962 | 200 | 50 | 320 | 1,305 | K, 11,130 | 34 | 0.8 |
|  | Tuymazy, 1937 | 1,400 | 40 | 1,540 | 760 | Paleoz., 5,610 | 33 | 2.0 |
|  | Uzen, 1961 | 1,350 | 115 | 730 | 4,525 | J, 2,667 | 33.9 | 0.20 |
|  | Ust-Balyk, 1961 | 820 | 122 | 742 | 2,105 | LK, 8,845 | 29 | 1.3 |
|  | Usa, 1963 | 110 | 30 | 51 | 560 | Paleo., 6,510 | 15.6 | .... |
|  | Yarino et al, 1956 | 300 | 30 | 440 | 200 | Carb., 6,070 | 41 | 0.6 |
|  | Zapadno-Surgut, 1962 | 230 | 35 | 235 | 495 | K, 7,628 | 29 | 1.5 |
| VENEZUELA |  |  |  |  |  |  |  |  |
|  | Chimire, 1948-1952 | 56 | 3 | 345 | 278 | Oficina, 7,200 | 34.0 |  |
| Anzoatequi | Dacion, 1957 | 53 | 5 | 178 | 42 | Oficina, 6,700 | 21.0 |  |
|  | Guara, 1946 | 168 | 10 | 507 | 378 | Oficina, 10,000 | 28.0 |  |
|  | Leona, 1938 | 94 | 5 | 140 | 60 | Oficina, 12,800 | 22.0 |  |
|  | Mata, 1954 | 103 | 10 | 458 | 653 | Oficina, 12,500 | 33.9 | .... |
|  | Merey, 1937 | 171 | 7 | 185 | 66 | Oficina, 5,700 | 12.0 |  |
|  | Nipa, 1945 | 92 | 7 | 441 | 274 | Oficina, 8,500 | 29.0 |  |
|  | Oficina, 1937 | 215 | 14 | 666 | 498 | Oficina, 5,900 |  | 0.59 |
|  | Oscurote, 1952 | 31 | 2 | 113 | 30 | Oficina, 9,513 | 20.0 | .... |
|  | Soto, 1950 | 38 | 2 | 164 | 38 | Oficina, 9,500 | 37.3 | .... |
|  | Zapatos, 1955 | 18 | 4 | 119 | 57 | Oficina, 11,500 | 36.0 | .... |
| Monagas |  |  |  |  |  |  |  |  |
|  | Morichal, 1958 | 106 | 8 | 123 | 82 | , 3,312 | 10.3 | .... |
|  | Oritupano, 1950 | 92 | 7 | 112 | 175 | , 7,657 | 19.2 | .... |
|  | Quiriguire, 1928 | 369 | 5 | 727 | 763 | Zeta, Eta, Theta, 7,200 | 16.3 | .... |
|  | Santa Barbara, 1941 | 80 | 1 | 160 | 19 | , 6,500 | 28.3 | .... |
|  | Temblador, 1936 | 38 | 2 | 101 | 15 | , 4,500 | 19.7 | .... |

|  |  |  |  | Millions of bbl |  |  |  |  |
|---|---|---|---|---|---|---|---|---|
| Country | Field, disc. date | No. wells | 1975 prod. | Cumulative production 1/1/76 | Estimated reserves 1/1/76 | Pay, ft | API gravity° | Sulfur wt % |
| Guarico | Las Mercedes, 1942 | 45 | 0.8 | 129 | 12 | ...., 4,500 | 28.7 | .... |
| Burinas | Silvestre, 1948 | 27 | 3 | 113 | 71 | ...., 8,862 | 25.0 | .... |
|  | Sinco, 1953 | 41 | 6 | 202 | 158 | Miocene, 9,100 | 24.4 | .... |
| Zulia | • Bachaquero, 1930 | 1,925 | 153 | 4,953 | 1,684 | Tertiary, 3,444 | 21.1 | 2.62 |
|  | Boscan, 1946 | 269 | 19 | 513 | 523 | Boscan, 7,500 | 10.4 | 5.53 |
|  | • Cabimas, 1917 | 641 | 32 | 1,303 | 300 | LaRosa, 2,200 | 27.3 | 1.71 |
|  | Centro, 1959 | 94 | 40 | 406 | 316 | Cretaceous, 12,568 | 36.8 | .... |
|  | Cruces Manueles, 1916 | 76 | 2 | 164 | 21 | ...., 8,000 | 31.7 | .... |
|  | Cueta, 1956 | 55 | 21 | 267 | 134 | ...., 11,000 | 28.5 | .... |
|  | La Concepcion, 1953 | 67 | 2 | 7 | 7 | ...., 8,000 | 34.7 | .... |
|  | Lago, 1958 | 36 | 19 | 139 | 172 | ...., 11,450 | 31.1 | .... |
|  | • Lagunillas, 1926 | 2,335 | 201 | 8,485 | 2,003 | Tertiary, 3,000 | 24.4 | 2.18 |
|  | Lama, 1957 | 181 | 70 | 1,902 | 2,241 | Tertiary, 8,320 | 32.6 | .... |
|  | Lamar, 1958 | 79 | 44 | 196 | 664 | Tertiary, 13,003 | 34.2 | .... |
|  | La Paz, 1925 | 76 | 7 | 792 | 845 | Gusara, 8,000 | 31.7 | .... |
|  | Mara, 1945 | 41 | 4 | 383 | 380 | Cret., Tert., 5,248 | 25.7 | .... |
|  | Mene Grande, 1914 | 309 | 5 | 585 | 583 | Eocene, 4,132 | 4.0 | 2.65 |
|  | Tia Juana, 1928 | 1,585 | 89 | 2,998 | 1,497 | Tertiary, 3,000 | 19.4 | 1.49 |
| ZAIRE | • GCO, 1970 | 7 | ... | .... | ... | ...., 8,500-10,000 | 35.0 | .... |
|  | • Mibale | 3 | ... | .... | ... | ...., 5,000-6,000 | 31.0 | .... |

• Offshore fields.

# APPENDIX I

## PETROLEUM REFINERIES IN THE UNITED STATES AND PUERTO RICO

The listing of petroleum refineries in the United States and Puerto Rico is from "Mineral Industry Survey", U. S. Department of Interior, Bureau of Mines, 1 January 1977.

Legible copies of the data appearing in Aggendix I, pages 748 through 756 can be obtained from:

Mr. William Whelan
U.S. Environmental Protection Agency
Industrial Environmental Research Laboratory
Research Triangle Park, N.C.  27711

## - CAPACITY OF PETROLEUM REFINERIES IN THE UNITED STATES AND PUERTO RICO: JANUARY 1, 1977
(BARRELS PER CALENDAR DAY)

| COMPANY | LOCATION | CRUDE OIL DISTILLATION | | | | CRACKING, REFORMING, COKING, AND ALKYLATION | | | | OTHER PRODUCTS[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | OPERABLE | | | INOPERABLE SHUTDOWN | TYPE OF PROCESS[1] | CHARGE | GASOLINE OUTPUT | | |
| | | TOTAL | OPERATING | SHUTDOWN | | | OPERATING AND SHUTDOWN | OPERATING | SHUTDOWN | |
| ALABAMA | | | | | | | | | | |
| HUNT OIL CO. | TUSCALOOSA | 30,000 | 30,000 | - | - | CAT. RF. | 5,500 | 5,200 | - | A |
| LOUISIANA LAND & EXPLORATION CO | MOBILE | 39,636 | 38,432 | 1,204 | - | - | - | - | - | - |
| MARION CORP | THEODORE | 19,200 | 19,200 | - | - | - | - | - | - | - |
| VULCAN ASPHALT REFINING CO. | CORDOVA | 5,000 | 5,000 | - | - | - | - | - | - | A |
| WARRIOR ASPHALT CORP. | HOLT | 3,000 | 3,000 | - | - | - | - | - | - | A |
| ALASKA | | | | | | | | | | |
| CHEVRON U.S.A. INC (FORMERLY STAND. OIL CO. OF CALIF.) | KENAI | 22,000 | 22,000 | - | - | - | - | - | - | A |
| TESORO-ALASKAN PETROLEUM CORP. | DO | 38,000 | 38,000 | - | - | CAT. RF. | 6,200 | 6,000 | - | - |
| ARIZONA | | | | | | | | | | |
| ARIZONA FUELS, INC. | FREDONIA | 5,000 | 5,000 | - | - | - | - | - | - | A |
| ARKANSAS | | | | | | | | | | |
| BERRY PETROLEUM CO., A SUBSIDIARY OF CRYSTAL OIL CO. | STEPHENS | 3,500 | 3,500 | - | - | - | - | - | - | A |
| CROSS OIL & REFINING CO. OF ARKANSAS | SMACKOVER | 6,000 | 4,200 | 1,800 | - | - | - | - | - | A-L |
| LION OIL CO., A SUBSIDIARY OF TOSCO CORP. | EL DORADO | 47,000 | 47,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 15,000<br>6,000<br>5,000 | 9,000<br>4,600<br>3,400 | -<br>-<br>- | A-L |
| MACMILLAN RING-FREE OIL CO. INC. | NORPHLET | 4,500 | 4,500 | - | - | - | - | - | - | A-L |
| CALIFORNIA | | | | | | | | | | |
| ATLANTIC RICHFIELD CO. | CARSON | 185,000 | 185,000 | - | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>COK.<br>THML. CR.<br>ALK. | 61,600<br>33,500<br>17,000<br>28,740<br>50,950<br>10,770 | 26,000<br>26,000<br>17,400<br>5,330<br>5,590<br>7,000 | -<br>-<br>-<br>-<br>-<br>- | A |
| BASIN PETROLEUM INC[a] | LONG BEACH | 3,000 | 3,000 | - | - | - | - | - | - | - |
| BEACON OIL CO. | HANFORD | 12,400 | 12,400 | - | - | CAT. RF.<br>THML. CR. | 1,650<br>3,675 | 1,600<br>3,150 | -<br>- | - |
| CHAMPLIN PETROLEUM CO. | WILMINGTON | 30,700 | 30,700 | - | - | COK. | 10,600 | 3,000 | - | A |
| CHEVRON U.S.A. INC (FORMERLY STAND. OIL CO. OF CALIF.) | BAKERSFIELD | 26,000 | 26,000 | - | - | CAT. RF.<br>THML. CR. | 9,230<br>9,000 | 2,600<br>- | -<br>2,000 | - |
| DO | EL SEGUNDO | 405,000 | 230,000 | 175,000 | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>COK.<br>ALK. | 43,000<br>55,000<br>45,000<br>50,000<br>5,600 | 19,000<br>46,000<br>47,500<br>7,500<br>5,600 | -<br>-<br>-<br>-<br>- | A-L |
| DO | RICHMOND | 365,000 | 338,000 | 27,000 | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>ALK. | 50,000<br>81,000<br>66,000<br>8,500 | 26,500<br>66,800<br>64,000<br>8,500 | -<br>-<br>-<br>- | A-L-W |
| DEMENNO RESOURCES | COMPTON | 2,500 | 2,500 | - | - | - | - | - | - | - |
| DOUGLAS OIL CO. OF CALIFORNIA | PARAMOUNT | 46,500 | 46,500 | - | - | CAT. RF. | 10,000 | 8,500 | - | A |
| DO | SANTA MARIA | 9,500 | 9,500 | - | - | - | - | - | - | A |
| E C O PETROLEUM INC[a] | LONG BEACH | 3,000 | 3,000 | - | - | - | - | - | - | - |
| EDGINGTON OIL COMPANY INC | DO | 29,500 | 29,500 | - | - | - | - | - | - | A |
| EDGINGTON OXNARD REFINERY | OXNARD | 2,500 | 2,500 | - | - | - | - | - | - | A |
| EXXON CO., U.S.A. | BENICIA | 88,000 | 88,000 | - | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>COK.<br>ALK. | 42,000<br>22,800<br>20,900<br>19,500<br>12,000 | 21,000<br>19,400<br>16,500<br>3,000<br>10,900 | -<br>-<br>-<br>-<br>- | A |
| FLETCHER OIL & REFINING CO. | CARSON | 20,100 | 20,100 | - | - | CAT. RF. | 4,200 | 4,200 | - | - |
| GOLDEN EAGLE REFINING CO. INC. | DO | 17,000 | 13,000 | 4,000 | - | - | - | - | - | - |
| GULF OIL CORP. | SANTA FE SPRINGS | 51,500 | 51,500 | - | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>THML. CR.<br>ALK. | 12,000<br>17,800<br>10,350<br>12,800<br>5,620 | 7,224<br>15,000<br>3,050<br>400<br>2,800 | -<br>-<br>-<br>-<br>- | A |
| KERN COUNTY REFINERY INC. | BAKERSFIELD | 15,900 | 15,900 | - | - | CAT. RF.<br>THML. CR. | 2,100<br>6,530 | 1,900<br>800 | -<br>- | - |
| LION OIL CO (FORMERLY PHILLIPS PETROLEUM CO.) | AVON | 126,000 | 126,000 | - | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>COK.<br>ALK. | 47,000<br>32,500<br>22,000<br>42,000<br>13,000 | 17,000<br>25,100<br>15,900<br>8,800<br>10,300 | -<br>-<br>-<br>-<br>- | A |
| DO (FORMERLY TOSCOPETRO CORP.) | BAKERSFIELD | 40,000 | 40,000 | - | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>COK.<br>ALK. | 12,000<br>15,000<br>13,000<br>7,000<br>3,530 | 6,000<br>12,750<br>16,000<br>600<br>3,800 | -<br>-<br>-<br>-<br>- | A |
| LUNDAY-THAGARD OIL CO. | SOUTH GATE | 8,500 | 3,222 | 5,278 | - | - | - | - | - | A |
| MACMILLAN RING-FREE OIL CO. INC. | LONG BEACH | 12,200 | 12,200 | - | - | - | - | - | - | - |
| MOBIL OIL CORP. | TORRANCE | 123,500 | 123,500 | - | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>COK.<br>THML. CR.<br>ALK. | 52,000<br>33,230<br>36,900<br>60,930<br>15,200<br>12,632 | 26,400<br>27,900<br>17,900<br>9,000<br>-<br>9,200 | -<br>-<br>-<br>-<br>[a] 2,600<br>- | A |
| MOHAWK PETROLEUM CORP. | BAKERSFIELD | 22,100 | 22,100 | - | - | CAT. RF. | 2,500 | 2,200 | - | - |
| NEWHALL REFINING CO., INC. | NEWHALL | 11,500 | 11,500 | - | - | - | - | - | - | A |
| PACIFIC REFINING CO INC (FORMERLY GULF OIL CORP.) | HERCULES | 53,300 | 53,300 | - | - | CAT. RF.<br>HYDRO. | 15,000<br>2,700 | 15,000<br>2,760 | -<br>- | - |
| POWERINE OIL CO. | SANTA FE SPRINGS | 46,120 | 46,120 | - | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>ALK. | 10,230<br>6,460<br>1,800<br>2,700 | 5,750<br>5,700<br>-<br>1,900 | -<br>-<br>1,950<br>- | A |
| ROAD OIL SALES INC. | BAKERSFIELD | 1,500 | 500 | 1,000 | - | - | - | - | - | - |
| SABRE OIL & REFINING INC | DO | 3,500 | 3,500 | - | - | - | - | - | - | - |
| SAN JOAQUIN OIL CO. | DO | 27,000 | 20,000 | 7,000 | - | - | - | - | - | A |

- CAPACITY OF PETROLEUM REFINERIES IN THE UNITED STATES AND PUERTO RICO: JANUARY 1, 1977 (CONTINUED)
(BARRELS PER CALENDAR DAY)

| COMPANY | LOCATION | CRUDE OIL DISTILLATION |  |  |  | CRACKING, REFORMING, COKING, AND ALKYLATION |  |  |  | OTHER PRODUCTS[2] |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | OPERABLE |  |  | INOPERABLE SHUTDOWN | TYPE OF PROCESS[1] | CHARGE | GASOLINE OUTPUT |  |  |
|  |  | TOTAL | OPERATING | SHUTDOWN |  |  | OPERATING AND SHUTDOWN | OPERATING | SHUTDOWN |  |
| CALIFORNIA (CONT.) |  |  |  |  |  |  |  |  |  |  |
| SHELL OIL CO. | MARTINEZ | 100,000 | 87,400 | 12,600 | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>ALK. | 43,230<br>24,300<br>18,430<br>9,300 | 10,400<br>20,500<br>5,800<br>6,600 | -<br>-<br>-<br>- | A-L |
| DO | WILMINGTON | 98,000 | 98,000 | - | 6,000 | CAT. CR.<br>CAT. RF.<br>COK.<br>ALK. | 33,030<br>18,500<br>33,000<br>11,100 | 15,000<br>15,700<br>6,000<br>8,300 | -<br>-<br>-<br>- | A |
| SUNLAND REFINING CORP. | BAKERSFIELD | 13,000 | 13,000 | - | - | CAT. RF. | 1,000 | 1,000 | - | - |
| TEXACO INC. | WILMINGTON | 75,000 | 62,500 | 12,500 | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>COK.<br>ALK. | 28,000<br>35,030<br>20,000<br>48,000<br>6,700 | 11,000<br>30,000<br>20,000<br>9,000<br>6,600 | -<br>-<br>-<br>-<br>- | B |
| U.S.A. PETROCHEM CORP | VENTURA | 15,000 | 15,000 | - | - | CAT. RF. | 6,000 | 5,000 | - | - |
| UNION OIL CO. OF CALIFORNIA | ARROYO GRANDE | 41,000 | 41,000 | - | - | COK. | 22,500 | 4,200 | - | A-B |
| DO | RODEO | 78,000 | 78,000 | - | - | CAT. RF.<br>HYDRO.<br>COK. | 22,500<br>27,030<br>17,330 | 21,000<br>27,000<br>3,000 | -<br>-<br>- | A-B-L-W |
| DO | WILMINGTON | 108,000 | 108,000 | - | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>THML. CR.<br>ALK. | 42,330<br>38,030<br>19,000<br>18,500<br>9,830 | 19,000<br>32,000<br>19,000<br>2,000<br>2,500 | -<br>-<br>-<br>-<br>- | A |
| WEST COAST OIL CO. | OILDALE | 15,000 | 15,000 | - | - | - | - | - | - | A |
| WITCO CHEMICAL CORP. | DO | 11,000 | 11,000 | - | - | - | - | - | - | A-L |
| COLORADO |  |  |  |  |  |  |  |  |  |  |
| ASAMERA OIL (U S) INC (FORMERLY THE REFINERY CORP.) | COMMERCE CITY | 21,500 | 21,500 | - | - | CAT. CR.<br>CAT. RF.<br>THML. CR. | 7,500<br>3,400<br>4,030 | 5,300<br>2,900<br>300 | -<br>-<br>- | - |
| CONTINENTAL OIL CO | DO | 32,500 | 32,500 | - | - | CAT. CR.<br>CAT. RF. | 15,000<br>6,530 | 9,000<br>5,500 | -<br>- | A |
| GARY WESTERN CO[8] | FRUITA | - | - | - | - | CAT. RF.<br>COK. | 2,565<br>9,200 | 2,190<br>2,565 | -<br>- | B |
| MORRISON REFINING CO. | GRAND JUNCTION | - | - | - | 1,800 | - | - | - | - | - |
| DELAWARE |  |  |  |  |  |  |  |  |  |  |
| GETTY OIL CO. | DELAWARE CITY | 140,000 | 140,000 | - | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>COK.<br>ALK. | 60,000<br>37,030<br>15,500<br>39,330<br>12,500 | 39,200<br>27,000<br>5,200<br>8,800<br>8,500 | -<br>-<br>-<br>-<br>- | - |
| FLORIDA |  |  |  |  |  |  |  |  |  |  |
| SEMINOLE ASPHALT & REFINING INC.[8] | ST MARKS | 6,000 | 6,000 | - | - | - | - | - | - | A |
| GEORGIA |  |  |  |  |  |  |  |  |  |  |
| AMOCO OIL CO. | SAVANNAH | 15,000 | 15,000 | - | - | - | - | - | - | A |
| YOUNG REFINING CORP | DOUGLASVILLE | 5,000 | 5,000 | - | - | - | - | - | - | A |
| HAWAII |  |  |  |  |  |  |  |  |  |  |
| CHEVRON U.S.A. INC (FORMERLY STAND. OIL CO. OF CALIF.) | HONOLULU | 40,000 | 40,000 | - | - | CAT. CR.<br>ALK. | 17,530<br>3,930 | 11,500<br>3,900 | -<br>- | A |
| ILLINOIS |  |  |  |  |  |  |  |  |  |  |
| AMOCO OIL CO. | WOOD RIVER | 95,000 | 95,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 38,030<br>12,300<br>7,030 | 24,000<br>10,500<br>5,500 | -<br>-<br>- | A |
| BI-PETRO INC | PANA | 1,000 | 1,000 | - | - | - | - | - | - | A |
| CLARK OIL & REFINING CORP. | BLUE ISLAND | 70,000 | 70,000 | - | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>ALK. | 26,000<br>30,530<br>11,000<br>7,000 | 16,000<br>25,200<br>3,000<br>6,000 | -<br>-<br>-<br>- | - |
| DO | HARTFORD | 55,000 | 55,000 | - | - | CAT. CR.<br>CAT. RF.<br>COK.<br>ALK. | 24,000<br>9,000<br>13,030<br>7,500 | 19,500<br>8,100<br>1,300<br>6,000 | -<br>-<br>-<br>- | B |
| MARATHON OIL CO. | ROBINSON | 195,000 | 195,000 | - | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>COK.<br>THML. CR.<br>ALK. | 35,030<br>67,400<br>20,400<br>18,200<br>2,830<br>15,050 | 23,900<br>36,900<br>7,600<br>6,550<br>500<br>7,800 | -<br>-<br>-<br>-<br>-<br>3,050 | B |
| MOBIL OIL CORP. | JOLIET | 180,000 | 180,000 | - | - | CAT. CR.<br>CAT. RF.<br>COK.<br>ALK. | 80,500<br>44,100<br>29,500<br>28,850 | 43,100<br>38,100<br>6,200<br>21,200 | -<br>-<br>-<br>- | B |
| RICHARDS, R. T. INC. | CROSSVILLE | 190 | 190 | - | - | - | - | - | - | - |
| SHELL OIL CO. | WOOD RIVER | 283,000 | 283,000 | - | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>THML. CR.<br>ALK. | 80,000<br>83,000<br>27,000<br>19,000<br>24,700 | 45,000<br>67,000<br>9,000<br>2,000<br>20,000 | -<br>-<br>-<br>-<br>- | A-L-W |
| TEXACO INC. | LAWRENCEVILLE | 84,000 | 84,000 | - | - | CAT. CR.<br>CAT. RF.<br>THML. CR.<br>ALK. | 34,000<br>24,000<br>9,000<br>6,900 | 18,000<br>20,000<br>4,000<br>6,600 | -<br>-<br>-<br>- | A |

CAPACITY OF PETROLEUM REFINERIES IN THE UNITED STATES AND PUERTO RICO: JANUARY 1, 1977 (CONTINUED)
(BARRELS PER CALENDAR DAY)

| COMPANY | LOCATION | CRUDE OIL DISTILLATION | | | | CRACKING, REFORMING, COKING, AND ALKYLATION | | | | OTHER PRODUCTS[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | OPERABLE | | | INOPERABLE SHUTDOWN | TYPE OF PROCESS[1] | CHARGE | GASOLINE OUTPUT | | |
| | | TOTAL | OPERATING | SHUTDOWN | | | OPERATING AND SHUTDOWN | OPERATING | SHUTDOWN | |
| ILLINOIS (CONT.) | | | | | | | | | | |
| TEXACO INC. | LOCKPORT | 72,000 | 72,000 | - | - | CAT. CR.<br>CAT. RF.<br>COK.<br>ALK. | 30,000<br>19,000<br>27,000<br>9,000 | 14,000<br>16,300<br>5,800<br>8,000 | -<br>-<br>-<br>- | [illegible] |
| UNION OIL CO. OF CALIFORNIA | LEMONT | 151,000 | 151,000 | - | - | CAT. CR.<br>CAT. RF.<br>COK.<br>ALK. | 55,000<br>29,000<br>21,400<br>21,000 | 32,700<br>24,300<br>1,600<br>13,800 | -<br>-<br>-<br>- | [illegible] |
| WIREBACK OIL CO[6] | PLYMOUTH | 1,100 | 1,100 | - | - | - | - | - | - | - |
| VETTER OIL CO. | COLMAR | 1,000 | 1,000 | - | - | - | - | - | - | - |
| INDIANA | | | | | | | | | | |
| AMOCO OIL CO. | WHITING | 365,000 | 365,000 | - | - | CAT. CR.<br>CAT. RF.<br>COK.<br>ALK. | 133,000<br>91,000<br>20,000<br>24,000 | 73,000<br>44,000<br>4,000<br>20,000 | -<br>[7] 29,000<br>-<br>- | A-B-L-W |
| CITIES SERVICE OIL CO.[11] | EAST CHICAGO | - | - | - | - | CAT. RF.<br>ALK. | 14,000<br>9,020 | -<br>- | [8] 12,000<br>[8] 6,060 | - |
| ENERGY COOPERATIVE INC (FORMERLY ATLANTIC RICHFIELD CO) | DO | 126,000 | 126,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 48,000<br>41,500<br>7,520 | 26,000<br>16,800<br>6,060 | -<br>[8] 17,500<br>- | A |
| GLADIEUX REFINERY, INC. | FT WAYNE | 12,200 | 12,200 | - | - | - | - | - | - | - |
| INDIANA FARM BUREAU COOPERATIVE ASSOCIATION INC. | MT VERNON | 21,200 | 21,200 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 6,300<br>3,030<br>1,990 | 4,060<br>2,800<br>1,350 | -<br>-<br>- | - |
| LAKETON ASPHALT REFINING CO. | LAKETON | 8,500 | 8,500 | - | - | - | - | - | - | A |
| MOBIL OIL CORP.[6] | EAST CHICAGO | - | - | - | 47,000 | CAT. CR.<br>CAT. RF.<br>THML. CR.<br>ALK. | 18,520<br>10,400<br>7,300<br>2,900 | -<br>-<br>-<br>- | [8] 10,300<br>[8] 8,900<br>[8] 1,400<br>2,900 | A |
| PRICETON REFINERY INC (FORMERLY CRYSTAL-PRINCETON CO.) | PRINCETON | 6,300 | - | 6,300 | - | - | - | - | - | - |
| ROCK ISLAND REFINING CORP. | INDIANAPOLIS | 43,200 | 43,200 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 16,000<br>7,630<br>4,700 | 11,000<br>7,400<br>4,000 | -<br>-<br>- | A |
| SOMERSET REFINERY INC. | TROY | - | - | - | 1,500 | - | - | - | - | - |
| WITCO CHEMICAL CORP. | HAMMOND | 9,800 | - | 9,800 | - | - | - | - | - | - |
| KANSAS | | | | | | | | | | |
| AMERICAN PETROFINA CO OF TEXAS | EL DORADO | 25,000 | 25,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 11,500<br>[8] 6,530<br>2,500 | 6,500<br>4,000<br>2,000 | -<br>-<br>- | A |
| APCO OIL CORP. | ARKANSAS CITY | 46,230 | 38,020 | 8,210 | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>ALK. | 9,430<br>16,500<br>3,000<br>3,750 | 6,230<br>16,850<br>2,960<br>2,300 | -<br>-<br>-<br>- | A |
| CRA, INC. | COFFEYVILLE | 48,000 | 39,531 | 8,469 | - | CAT. CR.<br>CAT. RF.<br>COK.<br>ALK. | 16,000<br>8,400<br>8,530<br>6,100 | 9,030<br>7,500<br>1,460<br>3,500 | -<br>-<br>-<br>- | A-B-L-W |
| DO | PHILLIPSBURG | 26,450 | 20,176 | 6,274 | - | CAT. CR.<br>CAT. RF.<br>ALK. | 8,530<br>5,300<br>2,530 | 5,000<br>4,700<br>1,400 | -<br>-<br>- | [illegible] |
| DERBY REFINING CO. | WICHITA | 27,992 | 27,992 | - | - | CAT. CR.<br>CAT. RF.<br>COK.<br>ALK. | 10,200<br>6,830<br>3,800<br>4,032 | 5,900<br>4,176<br>995<br>2,762 | -<br>-<br>-<br>- | A |
| E-Z SERV INC (FORMERLY NORTH AMERICAN PETROLEUM CORP.). | SHALLOW WATER | 10,000 | 10,000 | - | - | - | - | - | - | A |
| MID-AMERICA REFINING CO INC | CHANUTE | 3,100 | 3,100 | - | - | - | - | - | - | A |
| MOBIL OIL CORP. | AUGUSTA | 50,000 | 50,000 | - | - | CAT. CR.<br>CAT. RF.<br>THML. CR.<br>ALK. | 19,900<br>20,000<br>3,900<br>4,729 | 10,500<br>9,200<br>1,050<br>3,500 | 2,700<br>-<br>-<br>- | |
| NATIONAL COOPERATIVE REFINERY ASSOCIATION | MCPHERSON | 54,150 | 54,150 | - | - | CAT. CR.<br>CAT. RF.<br>COK.<br>ALK. | 19,000<br>8,651<br>16,350<br>9,056 | 11,970<br>5,850<br>1,941<br>5,700 | -<br>-<br>-<br>- | A |
| PHILLIPS PETROLEUM CO. | KANSAS CITY | 98,000 | 98,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 32,030<br>16,000<br>11,400 | 16,000<br>15,000<br>9,000 | -<br>-<br>- | A |
| SKELLY OIL CO. | EL DORADO | 78,731 | 78,731 | - | - | CAT. CR.<br>CAT. RF.<br>COK.<br>ALK. | 29,300<br>20,390<br>11,160<br>16,130 | 17,700<br>16,540<br>2,440<br>9,860 | -<br>-<br>-<br>- | A |
| KENTUCKY | | | | | | | | | | |
| ASHLAND OIL INC. | CATLETTSBURG | 135,000 | 135,000 | - | - | CAT. CR.<br>CAT. RF. | 52,400<br>26,000 | 32,000<br>21,500 | -<br>- | A |
| DO | LOUISVILLE | 25,200 | 25,200 | - | - | CAT. CR.<br>CAT. RF. | 9,530<br>3,000 | 5,600<br>2,360 | -<br>- | A |
| KENTUCKY OIL & REFINING INC | BETSY LANE | 3,250 | 3,000 | 250 | - | - | - | - | - | - |
| SOMERSET REFINERY INC. | SOMERSET | 5,000 | 5,000 | - | - | CAT. RF. | 1,000 | 1,000 | - | - |
| LOUISIANA INLAND | | | | | | | | | | |
| ATLAS PROCESSING CO. A SUBSIDIARY OF PENNZOIL CO. | SHREVEPORT | 45,000 | 45,000 | - | - | CAT. RF. | 10,030 | 10,000 | - | - |
| BAYOU STATE OIL CORP. | HOSSTON | 2,000 | 2,000 | - | - | - | - | - | - | A-L |
| DO | DO | 2,000 | 2,000 | - | - | - | - | - | - | A-L |
| CALUMET REFINING CO. A DIV. OF CALUMET INDUSTRIES INC. | PRINCETON | 2,400 | 2,400 | - | - | CAT. RF. | [illegible] | 2,000 | - | - |
| CLAIBORNE GASOLINE CO. | LISBON | 6,500 | 6,500 | - | - | - | - | - | - | - |
| COTTON VALLEY SOLVENTS CO. | COTTON VALLEY | 8,000 | 7,000 | 1,000 | - | - | - | - | - | - |
| KERR-MCGEE REFINING CORP. | DUBACH | 11,000 | 11,000 | - | - | CAT. RF. | 6,350 | 3,680 | - | - |

- CAPACITY OF PETROLEUM REFINERIES IN THE UNITED STATES AND PUERTO RICO: JANUARY 1, 1977 (CONTINUED)
(BARRELS PER CALENDAR DAY)

| COMPANY | LOCATION | CRUDE OIL DISTILLATION | | | | CRACKING, REFORMING, COKING, AND ALKYLATION | | | | OTHER PRODUCTS[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | OPERABLE | | | INOPERABLE SHUTDOWN | TYPE OF PROCESS[1] | CHARGE | GASOLINE OUTPUT | | |
| | | TOTAL | OPERATING | SHUTDOWN | | | OPERATING AND SHUTDOWN | OPERATING | SHUTDOWN | |
| LOUISIANA GULF | | | | | | | | | | |
| CANAL REFINING CO. | CHURCH POINT | 6,800 | 6,800 | - | - | CAT. RF. | 1,700 | 1,700 | - | - |
| CITIES SERVICE OIL CO. | LAKE CHARLES | 268,000 | 268,000 | - | - | CAT. CR. | 130,000 | 55,000 | - | 8 |
| | | | | | | CAT. RF. | 66,000 | 38,000 | - | |
| | | | | | | HYDRO. | 6,000 | 1,600 | - | |
| | | | | | | COK. | 28,000 | 7,000 | - | |
| | | | | | | ALK. | 44,000 | 33,000 | - | |
| CONTINENTAL OIL CO. | EGAN | 15,000 | 15,000 | - | - | CAT. RF. | 3,875 | 3,688 | - | - |
| DO | WESTLAKE | 83,000 | 83,000 | - | - | CAT. CR. | 24,000 | 13,000 | - | 8 |
| | | | | | | CAT. RF. | 17,800 | 15,100 | - | |
| | | | | | | COK. | 8,500 | 1,200 | - | |
| | | | | | | THRML. CR. | 6,000 | 1,200 | - | |
| | | | | | | ALK. | 7,000 | 4,200 | - | |
| EVANGELINE REFINING CO., INC. | JENNINGS | 5,000 | 5,000 | - | - | CAT. RF. | 600 | 600 | - | - |
| EXXON CO., U.S.A. | BATON ROUGE | 310,000 | 310,000 | - | - | CAT. CR. | 142,000 | 91,000 | - | 8-9-[illegible]-6 |
| | | | | | | CAT. RF. | 93,000 | 69,000 | - | |
| | | | | | | HYDRO. | 23,000 | 15,500 | - | |
| | | | | | | COK. | 62,500 | 10,600 | - | |
| | | | | | | ALK. | 37,000 | 28,400 | - | |
| GOOD HOPE REFINERIES, INC. | GOOD HOPE | 70,000 | 70,000 | - | - | CAT. CR. | 18,000 | 18,000 | - | - |
| | | | | | | CAT. RF. | 2,000 | 2,000 | - | 8 |
| GULF OIL CORP. | BELLE CHASSE | 185,900 | 185,900 | - | - | CAT. CR. | 75,700 | 68,900 | - | |
| | | | | | | CAT. RF. | 55,900 | 28,600 | - | |
| | | | | | | COK. | 15,200 | 9,000 | - | |
| | | | | | | ALK. | 42,000 | 27,500 | - | |
| DO | VENICE | 28,700 | 28,700 | - | - | CAT. RF. | 17,230 | 16,100 | - | - |
| | | | | | | HYDRO. | 11,200 | 9,600 | - | |
| HILL PETROLEUM, A SUBSIDIARY OF GOLDKING PETROLEUM CO. | KROTZ SPRINGS | 5,000 | 5,000 | - | - | - | - | - | - | - |
| LA JET INC | ST JAMES | 15,000 | 15,000 | - | - | - | - | - | - | - |
| MARATHON OIL CO (FORMERLY ECOL LTD.) | GARYVILLE | 200,000 | 200,000 | - | - | CAT. RF. | 37,530 | 33,000 | - | 8 |
| MURPHY OIL CORP. | MERAUX | 92,500 | 92,500 | - | 20,000 | CAT. CR. | 38,500 | 8,400 | - | - |
| | | | | | | CAT. RF. | 21,830 | 17,200 | - | |
| | | | | | | ALK. | 3,800 | 2,900 | - | |
| PLACID REFINING CO. | PORT ALLEN | 36,000 | 36,000 | - | - | CAT. RF. | 6,230 | 3,600 | - | - |
| SHELL OIL CO. | NORCO | 240,000 | 230,000 | 10,000 | - | CAT. CR. | 96,000 | 56,000 | - | 8-9 |
| | | | | | | CAT. RF. | 42,900 | 33,500 | - | |
| | | | | | | HYDRO. | 21,130 | 10,710 | - | |
| | | | | | | COK. | 16,200 | 3,000 | - | |
| | | | | | | THRML. CR. | 41,000 | 6,300 | - | |
| | | | | | | ALK. | 14,700 | 12,710 | - | |
| TENNECO OIL CO. | CHALMETTE | 86,000 | 86,000 | - | - | CAT. CR. | 20,000 | 11,000 | - | 8 |
| | | | | | | CAT. RF. | 33,000 | 28,000 | - | |
| | | | | | | HYDRO. | 16,000 | 12,000 | - | |
| | | | | | | COK. | 4,630 | 1,200 | - | |
| | | | | | | ALK. | 6,330 | 6,510 | - | |
| TEXACO INC. | CONVENT | 140,000 | 140,000 | - | - | CAT. CR. | 70,000 | 38,000 | - | - |
| | | | | | | CAT. RF. | 31,000 | 25,000 | - | |
| | | | | | | THRML. CR. | 12,000 | 1,000 | - | |
| | | | | | | ALK. | 15,000 | 12,500 | - | |
| MARYLAND | | | | | | | | | | |
| AMOCO OIL CO. | BALTIMORE | 13,000 | 13,000 | - | - | - | - | - | - | 8 |
| CHEVRON U.S.A. INC (FORMERLY CHEVRON ASPHALT CO.) | DO | 13,500 | - | 13,500 | - | - | - | - | - | 8 |
| MICHIGAN | | | | | | | | | | |
| CONSUMERS POWER CO | MARYSVILLE | 37,455 | 34,097 | 3,358 | - | - | - | - | - | - |
| CRYSTAL REFINING CO. | CARSON CITY | 6,200 | 6,200 | - | - | - | - | - | - | - |
| DOW CHEMICAL U.S.A. (FORMERLY BAY REFINING CO.) | BAY CITY | 20,000 | 17,000 | 3,000 | - | CAT. CR. | 6,030 | - | 3,500 | - |
| | | | | | | ALK. | 750 | - | 750 | |
| LAKESIDE REFINING CO. | KALAMAZOO | 5,600 | 5,600 | - | - | CAT. RF. | 2,000 | 2,000 | - | - |
| MARATHON OIL CO. | DETROIT | 65,000 | 65,000 | - | - | CAT. CR. | 25,050 | 15,800 | - | 8 |
| | | | | | | CAT. RF. | 15,470 | 13,300 | - | |
| | | | | | | ALK. | 6,030 | 3,650 | - | |
| MOBIL OIL CORP.[4] | WOODHAVEN | - | - | - | 46,600 | CAT. CR. | 18,000 | - | [3] 10,660 | 8 |
| | | | | | | CAT. RF. | 10,950 | - | [3] 7,750 | |
| | | | | | | COK. | 3,670 | - | [3] 880 | |
| | | | | | | ALK. | 3,930 | - | [3] 3,200 | |
| PETROLEUM SPECIALTIES, INC. | FLAT ROCK | - | - | - | 6,500 | CAT. RF. | 2,000 | - | [3] 1,500 | - |
| TEXAS AMERICAN PETROCHEMICAL (FORMERLY OSCEOLA REFG.) | WEST BRANCH | 17,000 | 12,500 | 4,500 | - | CAT. RF. | 1,530 | 1,500 | - | - |
| TOTAL PETROLEUM INC (FORMERLY TOTAL LEONARD INC.) | ALMA | 41,000 | 41,000 | - | - | CAT. CR. | 13,600 | 8,750 | [3] 2,550 | 8 |
| | | | | | | CAT. RF. | 12,450 | 8,550 | | |
| | | | | | | ALK. | 2,330 | 1,750 | - | |
| MINNESOTA | | | | | | | | | | |
| ASHLAND OIL INC | ST PAUL PARK | 67,143 | 67,143 | - | - | CAT. CR. | 21,000 | 12,500 | - | 8 |
| | | | | | | CAT. RF. | 11,030 | 9,000 | - | |
| | | | | | | ALK. | 4,600 | 3,200 | - | |
| CONTINENTAL OIL CO. | WRENSHALL | 23,500 | 23,500 | - | - | CAT. CR. | 9,350 | 5,900 | - | - |
| | | | | | | CAT. RF. | 3,200 | 2,200 | - | |
| KOCH REFINING CO. | ROSEMOUNT | 127,300 | 127,300 | - | - | CAT. CR. | 44,160 | 26,682 | - | 8-9 |
| | | | | | | CAT. RF. | 15,200 | 13,220 | - | |
| | | | | | | COK. | 22,580 | 5,810 | - | |
| | | | | | | ALK. | 9,530 | 8,360 | - | |
| MISSISSIPPI | | | | | | | | | | |
| AMERADA HESS CORP. | PURVIS | 30,000 | 30,000 | - | - | CAT. CR. | 16,230 | 9,000 | - | 8 |
| | | | | | | CAT. RF. | 5,430 | 4,500 | - | |
| | | | | | | COK. | 7,000 | 1,600 | - | |
| | | | | | | ALK. | 5,220 | 3,600 | - | |
| CHEVRON U.S.A. INC (FORMERLY STAND. OIL CO. OF KY.) | PASCAGOULA | 280,000 | 280,000 | - | - | CAT. CR. | 52,000 | 33,000 | - | - |
| | | | | | | CAT. RF. | 71,000 | 60,000 | - | |
| | | | | | | HYDRO. | 58,000 | 62,000 | - | |
| | | | | | | ALK. | 10,630 | 8,300 | - | |
| SOUTHLAND OIL CO. | LUMBERTON | 5,800 | 5,800 | - | - | - | - | - | - | - |

- CAPACITY OF PETROLEUM REFINERIES IN THE UNITED STATES AND PUERTO RICO: JANUARY 1, 1977 (CONTINUED)
(BARRELS PER CALENDAR DAY)

| COMPANY | LOCATION | CRUDE OIL DISTILLATION |  |  |  | CRACKING, REFORMING, COKING, AND ALKYLATION |  |  |  | OTHER PRODUCTS[2] |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | OPERABLE |  |  | INOPERABLE SHUTDOWN | TYPE OF PROCESS[1] | CHARGE | GASOLINE OUTPUT |  |  |
|  |  | TOTAL | OPERATING | SHUTDOWN |  |  | OPERATING AND SHUTDOWN | OPERATING | SHUTDOWN |  |
| MISSISSIPPI (CONT.) |  |  |  |  |  |  |  |  |  |  |
| SOUTHLAND OIL CO. | SANDERSVILLE | 11,000 | 11,000 | - | - | - | - | - | - | - |
| DO | YAZOO CITY | 4,200 | 4,200 | - | - | - | - | - | - | 3 |
| MISSOURI |  |  |  |  |  |  |  |  |  |  |
| AMOCO OIL CO. | SUGAR CREEK | 107,000 | 107,000 | - | - | CAT. CK. | 40,000 | 21,000 | - | 8-9 |
|  |  |  |  |  |  | CAT. RF. | 15,700 | 11,800 | - |  |
|  |  |  |  |  |  | COK. | 11,030 | 3,800 | - |  |
|  |  |  |  |  |  | ALK. | 5,200 | 4,360 | - |  |
| MONTANA |  |  |  |  |  |  |  |  |  |  |
| BIG WEST OIL CO. OF MONTANA | KEVIN | 5,123 | 5,123 | - | - | CAT. RF. | 1,000 | 800 | - | 8 |
|  |  |  |  |  |  | THML. CK. | 1,052 | 488 | - |  |
| CONTINENTAL OIL CO. | BILLINGS | 52,500 | 52,500 | - | - | CAT. CK. | 15,000 | 8,300 | - | 8 |
|  |  |  |  |  |  | CAT. RF. | 12,900 | 10,900 | - |  |
|  |  |  |  |  |  | ALK. | 5,200 | 3,330 | - |  |
| EXXON CO., U.S.A. | DO | 45,000 | 45,000 | - | - | CAT. CK. | 18,230 | 10,900 | - | 8-9 |
|  |  |  |  |  |  | CAT. RF. | 13,930 | 11,700 | - |  |
|  |  |  |  |  |  | HYDRO. | 4,600 | 4,600 | - |  |
|  |  |  |  |  |  | COK. | 4,700 | 850 | - |  |
|  |  |  |  |  |  | ALK. | 3,530 | 3,200 | - |  |
| FARMERS UNION CENTRAL EXCHANGE INC. | LAUREL | 41,650 | 33,650 | 8,000 | - | CAT. CK. | 11,500 | 11,000 | - | 8 |
|  |  |  |  |  |  | CAT. RF. | 12,030 | 12,000 | - |  |
|  |  |  |  |  |  | ALK. | 3,400 | 3,400 | - |  |
| JET FUEL REFINERY[6] | MOSBY | 1,000 | - | 1,000 | - | - | - | - | - | - |
| JOHN VIGHT, INC. | SHELBY | - | - | - | 1,500 | - | - | - | - | - |
| PHILLIPS PETROLEUM CO. | GREAT FALLS | 6,000 | 6,000 | - | - | CAT. CK. | 1,830 | 1,100 | - | 8 |
|  |  |  |  |  |  | CAT. RF. | 600 | 550 | - |  |
| TESORO PETROLEUM CORP | WOLF POINT | 2,500 | 2,500 | - | - | - | - | - | - | - |
| WESTCO REFINING CO. | CUT BANK | 4,658 | 4,658 | - | - | CAT. RF. | 950 | 760 | - | - |
|  |  |  |  |  |  | THML. CK. | 2,230 | 760 | - |  |
| NEBRASKA |  |  |  |  |  |  |  |  |  |  |
| CRA, INC. | SCOTTSBLUFF | 5,000 | 5,000 | - | - | CAT. CK. | 2,630 | 1,400 | - | - |
|  |  |  |  |  |  | CAT. RF. | 1,071 | 950 | - |  |
| NEVADA |  |  |  |  |  |  |  |  |  |  |
| NEVADA REFINING CO (FORMERLY J. A. LYDDON & ASSOCIATES) | TONOPAH | - | - | - | 500 | - | - | - | - | - |
| NEW HAMPSHIRE |  |  |  |  |  |  |  |  |  |  |
| A. JOHNSON AND CO. INC.[6] | NEWINGTON | 11,700 | 11,700 | - | - | - | - | - | - | - |
| NEW JERSEY |  |  |  |  |  |  |  |  |  |  |
| AMERADA HESS CORP | PORT READING | 67,900 | - | 67,900 | - | CAT. CK. | 32,830 | - | 20,300 | - |
|  |  |  |  |  |  | CAT. RF. | 8,600 | - | 7,200 |  |
|  |  |  |  |  |  | ALK. | 4,230 | - | 3,600 |  |
| CHEVRON U.S.A. INC (FORMERLY CHEVRON OIL CO.) | PERTH AMBOY | 168,000 | 168,000 | - | - | CAT. CK. | 28,500 | 14,000 | - | 8 |
|  |  |  |  |  |  | CAT. RF. | 26,030 | 20,000 | - |  |
|  |  |  |  |  |  | ALK. | 3,900 | 2,865 | - |  |
| EXXON CO., U.S.A. | LINDEN | 285,000 | 285,000 | - | - | CAT. CK. | 130,030 | 73,000 | - | 8 |
|  |  |  |  |  |  | CAT. RF. | 42,000 | 32,360 | - |  |
|  |  |  |  |  |  | ALK. | 9,830 | 8,400 | - |  |
| MOBIL OIL CORP. | PAULSBORO | 98,000 | 98,000 | - | - | CAT. CK. | 22,900 | 10,000 | - | 8-1-9 |
|  |  |  |  |  |  | CAT. RF. | 21,500 | 18,100 | - |  |
|  |  |  |  |  |  | COK. | 22,100 | 2,900 | - |  |
|  |  |  |  |  |  | ALK. | 2,973 | 2,200 | - |  |
| TEXACO INC. | WESTVILLE | 88,000 | 88,000 | - | - | CAT. CK. | 60,000 | 18,000 | - | - |
|  |  |  |  |  |  | CAT. RF. | 13,000 | 11,600 | - |  |
|  |  |  |  |  |  | THML. CK. | 13,000 | 1,000 | - |  |
|  |  |  |  |  |  | ALK. | 3,530 | 3,000 | - |  |
| NEW MEXICO |  |  |  |  |  |  |  |  |  |  |
| CARIBOU-FOUR CORNERS OIL CO. | FARMINGTON | 2,500 | 2,500 | - | - | - | - | - | - | - |
| GIANT INDUSTRIES INC | DO | 8,100 | 8,100 | - | - | - | - | - | - | - |
| NAVAJO REFINING CO | ARTESIA | 29,900 | 29,900 | - | - | CAT. CK. | 5,201 | 2,910 | - | 8 |
|  |  |  |  |  |  | CAT. RF. | 1,790 | 1,550 | - |  |
|  |  |  |  |  |  | THML. CK. | 1,251 | 600 | - |  |
|  |  |  |  |  |  | ALK. | 2,300 | 1,200 | - |  |
| PLATEAU, INC. | BLOOMFIELD | 3,649 | 3,649 | - | - | CAT. RF. | 2,250 | 2,000 | - | - |
| SHELL OIL CO. | GALLUP | 18,000 | 18,000 | - | 2,000 | CAT. CK. | 7,000 | 4,500 | - | 8 |
|  |  |  |  |  |  | CAT. RF. | 6,530 | 6,000 | - |  |
|  |  |  |  |  |  | ALK. | 1,700 | 1,400 | - |  |
| SOUTHERN UNION REFINING CO (FORMERLY FAMARIAN OIL & REFINING CO.) | LOVINGTON | 36,100 | 36,100 | - | - | - | - | - | - | - |
| DO | MONUMENT | 5,000 | 5,000 | - | - | CAT. RF. | 850 | 600 | - | - |
| THRIFTWAY OIL CO. | BLOOMFIELD | 7,500 | 7,500 | - | - | THML. CK. | 500 | 500 | - | - |
| NEW YORK |  |  |  |  |  |  |  |  |  |  |
| ASHLAND OIL INC. | BUFFALO | 64,000 | 64,000 | - | - | CAT. CK. | 22,000 | 13,000 | - | 8 |
|  |  |  |  |  |  | CAT. RF. | 11,000 | 9,000 | - |  |
| MOBIL OIL CORP. | DO | 43,000 | 43,000 | - | - | CAT. CK. | 18,030 | 8,900 | - | 8 |
|  |  |  |  |  |  | CAT. RF. | 11,000 | 8,800 | - |  |
|  |  |  |  |  |  | ALK. | 3,513 | - | 2,600 |  |

- CAPACITY OF PETROLEUM REFINERIES IN THE UNITED STATES AND PUERTO RICO: JANUARY 1, 1977 (CONTINUED)
(BARRELS PER CALENDAR DAY)

| COMPANY | LOCATION | CRUDE OIL DISTILLATION |  |  |  | CRACKING, REFORMING, COKING, AND ALKYLATION |  |  |  | FINSD. PRODUCTS |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | OPERABLE |  |  | INOPERABLE SHUTDOWN | TYPE OF PROCESS | CHARGE | GASOLINE OUTPUT |  |  |
|  |  | TOTAL | OPERATING | SHUTDOWN |  |  | OPERATING AND SHUTDOWN | OPERATING | SHUTDOWN |  |
| NORTH CAROLINA |  |  |  |  |  |  |  |  |  |  |
| TRANS OCEAN PETROLEUM INC (FORMERLY PACE OIL CO.).... | WILMINGTON ................ | 10,000 | 10,000 | - | - | - | - | - | - | - |
| NORTH DAKOTA |  |  |  |  |  |  |  |  |  |  |
| AMOCO OIL CO. .................................. | MANDAN .................... | 69,000 | 69,000 | - | - | CAT. CK. | 23,000 | 12,500 | - | - |
|  |  |  |  |  |  | CAT. RF. | 8,000 | 6,820 | - |  |
|  |  |  |  |  |  | ALK. | 6,400 | 2,600 | - |  |
| NORTHLAND OIL & REFINING CO. ..................... | DICKINSON ................. | 5,250 | 5,250 | - | - | THML. CK. | 2,500 | 2,500 | - | - |
| WESTLAND OIL CO. ................................. | WILLISTON ................. | 4,858 | 4,858 | - | - | CAT. CK. | 2,000 | 960 | - | - |
|  |  |  |  |  |  | THML. CK. | 1,100 | 880 | - |  |
| OHIO EAST |  |  |  |  |  |  |  |  |  |  |
| ASHLAND OIL INC. ................................ | CANTON .................... | 64,000 | 64,000 | - | - | CAT. CK. | 22,000 | 14,000 | - | A |
|  |  |  |  |  |  | CAT. RF. | 11,000 | 9,000 | - |  |
|  |  |  |  |  |  | ALK. | 7,000 | 5,000 | - |  |
| OHIO WEST |  |  |  |  |  |  |  |  |  |  |
| ASHLAND OIL INC.[10] ............................ | FINDLAY ................... | 20,400 | - | 20,400 | - | - | - | - | - | A |
| GULF OIL CORP. .................................. | CLEVES .................... | 42,700 | 42,700 | - | - | CAT. CK. | 17,400 | 11,100 | - | - |
|  |  |  |  |  |  | CAT. RF. | 9,600 | 8,500 | - |  |
|  |  |  |  |  |  | ALK. | 7,400 | 6,300 | - |  |
| DO .............................................. | TOLEDO .................... | 50,300 | 50,300 | - | - | CAT. CK. | 19,200 | 12,100 | - | P |
|  |  |  |  |  |  | CAT. RF. | 10,730 | 9,300 | - |  |
|  |  |  |  |  |  | ALK. | 7,800 | 5,300 | - |  |
| STANDARD OIL CO. OF OHIO ........................ | LIMA ...................... | 168,000 | 168,000 | - | - | CAT. CK. | 55,400 | 19,700 | - | A-P-L-W |
|  |  |  |  |  |  | CAT. RF. | 44,200 | 36,900 | - |  |
|  |  |  |  |  |  | HYDRO. | 18,230 | 6,000 | - |  |
|  |  |  |  |  |  | COK. | 14,900 | 700 | - |  |
| DO .............................................. | TOLEDO .................... | 120,000 | 120,000 | - | - | CAT. CK. | 49,400 | 29,100 | - | A-P |
|  |  |  |  |  |  | CAT. RF. | 38,900 | 33,200 | - |  |
|  |  |  |  |  |  | HYDRO. | 31,000 | 4,300 | - |  |
|  |  |  |  |  |  | COK. | 10,300 | 610 | - |  |
|  |  |  |  |  |  | ALK. | 13,000 | 9,500 | - |  |
| SUN CO INC (FORMERLY SUN OIL CO.) ............... | DO ........................ | 125,000 | 125,000 | - | - | CAT. CK. | 44,000 | 26,000 | - | P |
|  |  |  |  |  |  | CAT. RF. | 40,000 | 32,000 | - |  |
|  |  |  |  |  |  | HYDRO. | 25,000 | 22,000 | - |  |
|  |  |  |  |  |  | THML. RF. | 5,000 | - | 3,000 |  |
|  |  |  |  |  |  | ALK. | 13,500 | 7,000 | - |  |
| OKLAHOMA |  |  |  |  |  |  |  |  |  |  |
| ALLIED MATERIALS CORP. .......................... | STROUD .................... | 5,500 | 5,500 | - | - | - | - | - | - | A-L |
| APCO OIL CORP. .................................. | CYRIL ..................... | 14,000 | 14,000 | - | - | CAT. CK. | 6,000 | 3,942 | [9] 1,030 | A |
|  |  |  |  |  |  | CAT. RF. | 1,150 | - | - |  |
|  |  |  |  |  |  | ALK. | 2,400 | 1,600 | - |  |
| CHAMPLIN PETROLEUM CO. .......................... | ENID ...................... | 53,800 | 53,800 | - | - | CAT. CK. | 19,000 | 16,500 | - | P-A-L-W |
|  |  |  |  |  |  | CAT. RF. | 15,000 | 12,750 | - |  |
|  |  |  |  |  |  | COK. | 3,500 | 600 | - |  |
|  |  |  |  |  |  | ALK. | 7,500 | 6,000 | - |  |
| CONTINENTAL OIL CO. ............................. | PONCA CITY ................ | 126,000 | 126,000 | - | - | CAT. CK. | 41,000 | 26,300 | - | A-P-L-W |
|  |  |  |  |  |  | CAT. RF. | 29,400 | 25,000 | - |  |
|  |  |  |  |  |  | COK. | 15,500 | 2,800 | - |  |
|  |  |  |  |  |  | THML. CK. | 17,000 | - | [9] 1,800 |  |
|  |  |  |  |  |  | ALK. | 10,400 | 9,300 | - |  |
| KERR-MCGEE REFINING CORP. ....................... | WYNNEWOOD ................. | 50,000 | 50,000 | - | - | CAT. CK. | 11,500 | 8,000 | - | A |
|  |  |  |  |  |  | CAT. RF. | 7,530 | 6,500 | - |  |
|  |  |  |  |  |  | HYDRO. | 4,500 | 4,500 | - |  |
|  |  |  |  |  |  | ALK. | 3,500 | 3,500 | - |  |
| MIDLAND COOPERATIVE, INC. ....................... | CUSHING ................... | 19,800 | 19,800 | - | - | CAT. CK. | 7,370 | 6,400 | - | A |
|  |  |  |  |  |  | CAT. RF. | 4,650 | 3,500 | - |  |
|  |  |  |  |  |  | COK. | 5,700 | 776 | - |  |
|  |  |  |  |  |  | ALK. | 3,120 | 2,400 | - |  |
| OKC REFINING CO., INC. .......................... | OKMULGEE .................. | 25,000 | 22,902 | 2,098 | - | CAT. CK. | 8,000 | 6,100 | - | A |
|  |  |  |  |  |  | ALK. | 2,125 | 1,500 | - |  |
| SUN CO INC (FORMERLY SUN OIL CO.) ............... | DUNCAN .................... | 48,500 | 48,500 | - | - | CAT. CK. | 23,000 | 12,500 | - | A |
|  |  |  |  |  |  | CAT. RF. | 7,600 | 6,300 | - |  |
|  |  |  |  |  |  | COK. | 11,000 | 2,800 | - |  |
|  |  |  |  |  |  | ALK. | 9,000 | 6,000 | - |  |
| DO .............................................. | TULSA ..................... | 88,500 | 88,500 | - | - | CAT. CK. | 28,000 | 15,500 | - | A-P-L-W |
|  |  |  |  |  |  | CAT. RF. | 24,000 | 17,000 | - |  |
|  |  |  |  |  |  | COK. | 8,030 | 1,700 | - |  |
|  |  |  |  |  |  | ALK. | 12,000 | 8,200 | - |  |
| TEXACO INC. ..................................... | DO ........................ | 50,000 | 50,000 | - | - | CAT. CK. | 18,000 | 10,000 | - | A |
|  |  |  |  |  |  | CAT. RF. | 20,000 | 16,500 | - |  |
|  |  |  |  |  |  | THML. CK. | 6,000 | 3,000 | - |  |
|  |  |  |  |  |  | ALK. | 3,230 | 3,000 | - |  |
| TONKAWA REFINING CO. ............................ | ARNETT .................... | 5,000 | 3,954 | 1,046 | - | - | - | - | - | - |
| VICKERS PETROLEUM CORP. ......................... | ARDMORE ................... | 62,500 | 62,500 | - | - | CAT. CK. | 22,000 | 20,000 | - | A |
|  |  |  |  |  |  | CAT. RF. | 12,000 | 11,600 | - |  |
|  |  |  |  |  |  | ALK. | 5,400 | 4,900 | - |  |
| OREGON |  |  |  |  |  |  |  |  |  |  |
| CHEVRON U.S.A. INC.[10] (FORMERLY CHEVRON ASPHALT CO.) . | PORTLAND .................. | 14,000 | - | 14,000 | - | - | - | - | - | A |
| PENNSYLVANIA EAST |  |  |  |  |  |  |  |  |  |  |
| ATLANTIC RICHFIELD CO. .......................... | PHILADELPHIA .............. | 185,000 | 185,000 | - | - | CAT. RF. | 58,000 | 49,000 | - | A |
|  |  |  |  |  |  | HYDRO. | 76,000 | 11,000 | - |  |

CAPACITY OF PETROLEUM REFINERIES IN THE UNITED STATES AND PUERTO RICO: JANUARY 1, 1977 (CONTINUED)
(BARRELS PER CALENDAR DAY)

| COMPANY | LOCATION | CRUDE OIL DISTILLATION |  |  |  | CRACKING, REFORMING, COKING, AND ALKYLATION |  |  |  | OTHER PRODUCTS[2] |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | OPERABLE |  |  | INOPERABLE SHUTDOWN | TYPE OF PROCESS[1] | CHARGE | GASOLINE OUTPUT |  |  |
|  |  | TOTAL | OPERATING | SHUTDOWN |  |  | OPERATING AND SHUTDOWN | OPERATING | SHUTDOWN |  |
| PENNSYLVANIA EAST (CONT.) |  |  |  |  |  |  |  |  |  |  |
| B P OIL CORP. | MARCUS HOOK | 161,000 | 161,000 | - | - | CAT. CR.<br>CAT. RF.<br>HYDRO.<br>THML. CR.<br>ALK. | 42,530<br>45,100<br>21,430<br>11,000<br>9,730 | 25,400<br>38,100<br>8,800<br>-<br>7,900 | -<br>-<br>-<br>[5] 700<br>- | - |
| GULF OIL CORP. | PHILADELPHIA | 204,200 | 160,200 | 44,000 | - | CAT. CR.<br>CAT. RF.<br>ALK. | 81,800<br>49,330<br>23,300 | 31,800<br>41,800<br>- | 15,600<br>-<br>14,200 | - |
| SUN CO INC (FORMERLY SUN OIL CO.) | MARCUS HOOK | 165,000 | 165,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 73,530<br>66,500<br>15,630 | 40,000<br>34,000<br>10,600 | -<br>-<br>- | A-L-W |
| PENNSYLVANIA WEST |  |  |  |  |  |  |  |  |  |  |
| ASHLAND OIL INC (FORMERLY VALVOLINE OIL CO.) | FREEDOM | 6,800 | 6,800 | - | - | - | - | - | - | L-W |
| PENNZOIL CO. | ROUSEVILLE | 10,000 | 10,000 | - | - | CAT. RF. | 6,000 | 3,600 | - | L-W |
| PENRECO, A DIVISION OF PENNZOIL CO. | KARNS CITY | - | - | - | 1,600 | - | - | - | - | - |
| QUAKER STATE OIL REFINING CORP. | EMLENTON | 3,320 | 3,320 | - | - | CAT. RF.<br>THML. CR.<br>THML. RF. | 1,250<br>641<br>425 | 1,060<br>-<br>- | -<br>[5] 512<br>[5] 360 | L-W |
| DO | SMETHPORT | 6,500 | 6,500 | - | - | CAT. RF. | 2,320 | 2,340 | - | L-W |
| UNITED REFINING CO. | WARREN | 52,000 | 52,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 10,500<br>10,030<br>3,700 | 5,800<br>8,500<br>3,400 | -<br>-<br>- | A |
| WITCO CHEMICAL CORP. | BRADFORD | 9,000 | 9,000 | - | - | CAT. RF. | 2,330 | 1,800 | - | L-W |
| WOLFS HEAD OIL REFINING INC., A DIV. OF PENNZOIL CO. | RENO | 2,100 | 2,100 | - | - | - | - | - | - |  |
| RHODE ISLAND |  |  |  |  |  |  |  |  |  |  |
| MOBIL OIL CORP.[4] | EAST PROVIDENCE | - | - | - | 7,500 | - | - | - | - | A |
| TENNESSEE |  |  |  |  |  |  |  |  |  |  |
| DELTA REFINING CO.[4] | MEMPHIS | 43,900 | 43,900 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 13,500<br>10,030<br>6,000 | 6,300<br>8,500<br>4,000 | -<br>-<br>- | A |
| TEXAS INLAND |  |  |  |  |  |  |  |  |  |  |
| ADOBE REFINING CO., A SUBSIDIARY OF CRYSTAL OIL CO. | LA BLANCA | 5,000 | 5,000 | - | - | - | - | - | - | - |
| AMERICAN PETROFINA CO OF TEXAS | MOUNT PLEASANT | 26,000 | 26,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 9,000<br>6,530<br>2,400 | 4,700<br>3,710<br>2,100 | -<br>-<br>- | A |
| CHEVRON U.S.A. INC (FORMERLY CHEVRON OIL CO.) | EL PASO | 71,000 | 71,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 20,930<br>11,750<br>5,630 | 11,000<br>10,000<br>4,800 | -<br>[illegible]<br>- | A |
| COSDEN OIL & CHEMICAL CO. | BIG SPRING | 65,000 | 65,000 | - | - | CAT. CR.<br>CAT. RF.<br>THML. CR.<br>ALK. | 23,000<br>22,000<br>10,000<br>7,800 | 16,000<br>18,000<br>6,000<br>6,000 | -<br>-<br>-<br>- | A |
| DIAMOND SHAMROCK CORP. | SUNRAY | 51,500 | 51,500 | - | - | CAT. CR.<br>CAT. RF.<br>THML. CR.<br>ALK. | 23,000<br>16,000<br>3,930<br>8,700 | 12,000<br>14,000<br>1,500<br>9,000 | -<br>-<br>-<br>- | A |
| DORCHESTER GAS PRODUCING CO.[4] | WHITE DEER | - | - | - | - | CAT. RF. | [5] 1,030 | 1,000 | - | - |
| FLINT CHEMICAL CO. | SAN ANTONIO | 1,500 | 1,500 | - | - | - | - | - | - | - |
| GULF STATES OIL & REFINING CO. | QUITMAN | 4,500 | 4,500 | - | - | - | - | - | - | - |
| HOWELL HYDROCARBONS INC. | SAN ANTONIO | 3,500 | 3,500 | - | - | CAT. RF. | 750 | 500 | - | - |
| J & W REFINING INC. | PALESTINE | 10,000 | 4,000 | 6,000 | - | - | - | - | - | A |
| LA GLORIA OIL & GAS CO. | TYLER | 29,300 | 24,400 | 4,900 | - | CAT. CR.<br>CAT. RF.<br>COK.<br>THML. CR.<br>ALK. | 12,500<br>8,530<br>12,000<br>[5] 5,330<br>4,500 | 6,000<br>6,250<br>700<br>-<br>3,200 | -<br>-<br>-<br>[illegible]<br>- |  |
| LONGVIEW REFINING CO., A SUBSIDIARY OF CRYSTAL OIL CO. | LONGVIEW | 9,000 | 9,000 | - | - | CAT. RF. | 1,530 | 1,500 | - | A-W |
| PETROLITE CORP. | KILGORE | 1,000 | 1,000 | - | - | - | - | - | - | - |
| PHILLIPS PETROLEUM CO. | BORGER | 100,000 | 100,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 56,000<br>27,000<br>32,030 | 31,000<br>23,000<br>14,500 | -<br>-<br>- |  |
| PIONEER REFINING CO. | NIXON | 2,200 | 2,200 | - | - | - | - | - | - | - |
| PRIDE REFINING, INC. | ABILENE | 36,500 | 36,500 | - | - | - | - | - | - | - |
| SHELL OIL CO. | ODESSA | 32,000 | 32,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 9,030<br>10,500<br>2,880 | 5,500<br>8,400<br>2,440 | -<br>-<br>- | - |
| SIGMOR CORP. | THREE RIVERS | 10,000 | 10,000 | - | - | CAT. RF. | 3,100 | 3,400 | - | - |
| TESORO PETROLEUM CORP. | CARRIZO SPRINGS | 26,100 | 26,100 | - | - | - | - | - | - | A |
| TEXACO INC. | AMARILLO | 20,000 | 20,000 | - | - | CAT. CR.<br>CAT. RF.<br>COK.<br>ALK. | 9,000<br>5,000<br>4,000<br>1,830 | 6,000<br>6,000<br>1,000<br>1,500 | -<br>-<br>-<br>- |  |
| DO | EL PASO | 17,000 | 17,000 | - | - | CAT. CR.<br>CAT. RF.<br>COK.<br>ALK. | 7,000<br>3,530<br>4,000<br>1,730 | 4,000<br>3,000<br>1,000<br>1,500 | -<br>-<br>-<br>- | A |
| TEXAS ASPHALT & REFINING CO. | EULESS | 6,000 | 6,000 | - | - | - | - | - | - | - |
| THRIFTWAY OIL CO. | GRAHAM | 1,000 | 1,000 | - | - | - | - | - | - | - |
| WICKETT REFINING CO. | WICKETT | 8,000 | 8,000 | - | - | - | - | - | - | - |
| WINSTON REFINING CO. | FORT WORTH | 20,000 | 20,000 | - | - | CAT. CR.<br>CAT. RF. | 3,530<br>1,700 | 3,500<br>- | -<br>[5] 1,700 |  |

CAPACITY OF PETROLEUM REFINERIES IN THE UNITED STATES AND PUERTO RICO: JANUARY 1, 1977 (CONTINUED)
(BARRELS PER CALENDAR DAY)

| COMPANY | LOCATION | CRUDE OIL DISTILLATION | | | | CRACKING, REFORMING, COKING, AND ALKYLATION | | | | OTHER PRODUCTS[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | OPERABLE | | | INOPERABLE SHUTDOWN | TYPE OF PROCESS[1] | CHARGE | GASOLINE OUTPUT | | |
| | | TOTAL | OPERATING | SHUTDOWN | | | OPERATING AND SHUTDOWN | OPERATING | SHUTDOWN | |
| TEXAS GULF | | | | | | | | | | |
| AMERICAN PETROFINA CO OF TEXAS | PORT ARTHUR | 110,000 | 110,000 | - | - | CAT. CK.<br>CAT. RF.<br>THML. CK.<br>ALK. | 52,030<br>24,000<br>10,000<br>3,200 | 19,000<br>20,000<br>1,000<br>2,700 | -<br>-<br>-<br>- | - |
| AMOCO OIL CO. | TEXAS CITY | 348,000 | 348,000 | - | - | CAT. CK.<br>CAT. RF.<br>HYDRO.<br>COK.<br>ALK. | 153,600<br>113,000<br>36,830<br>29,000<br>33,030 | 80,000<br>94,300<br>36,800<br>5,800<br>27,100 | -<br>-<br>-<br>-<br>- | A-P |
| ATLANTIC RICHFIELD CO. | HOUSTON | 306,000 | 306,000 | - | 40,000 | CAT. CK.<br>CAT. RF.<br>COK. | 65,000<br>96,030<br>25,000 | 37,000<br>83,500<br>6,000 | -<br>-<br>- | P-L-W |
| CHAMPLIN PETROLEUM CO. | CORPUS CHRISTI | 125,000 | 125,000 | - | 30,000 | CAT. CK.<br>CAT. RF.<br>ALK. | 51,930<br>27,000<br>24,230 | 36,300<br>24,300<br>13,500 | -<br>-<br>- | - |
| CHARTER INTERNATIONAL OIL CO | HOUSTON | 70,000 | 70,000 | - | - | CAT. CK.<br>CAT. RF.<br>THML. CK.<br>ALK. | 24,000<br>13,530<br>9,030<br>6,500 | 13,500<br>12,220<br>500<br>6,500 | -<br>-<br>-<br>- | A |
| COASTAL STATES PETROCHEMICAL CO. | CORPUS CHRISTI | 185,000 | 185,000 | - | - | CAT. CK.<br>CAT. RF.<br>COK.<br>ALK. | 19,530<br>35,030<br>16,070<br>3,520 | 11,000<br>25,000<br>2,500<br>2,500 | -<br>-<br>-<br>- | P |
| CROWN CENTRAL PETROLEUM CORP | PASADENA | 100,000 | 100,000 | - | - | CAT. CK.<br>CAT. RF.<br>COK.<br>ALK. | 63,000<br>22,000<br>9,500<br>15,000 | 24,000<br>19,000<br>1,600<br>16,000 | -<br>-<br>-<br>- | P |
| EDDY REFINING CO.[4] | HOUSTON | 3,000 | 3,000 | - | - | - | - | - | - | - |
| EXXON CO., U.S.A. | BAYTOWN | 390,000 | 390,000 | - | - | CAT. CK.<br>CAT. RF.<br>HYDRO.<br>ALK. | 132,000<br>88,030<br>21,000<br>31,030 | 65,000<br>67,000<br>16,000<br>25,000 | -<br>-<br>7,000<br>- | A-L-W |
| GULF OIL CORP. | PORT ARTHUR | 312,100 | 312,100 | - | - | CAT. CK.<br>CAT. RF.<br>HYDRO.<br>COK.<br>ALK. | 117,700<br>43,130<br>14,500<br>27,830<br>26,030 | 72,400<br>52,300<br>14,650<br>6,000<br>19,300 | -<br>-<br>-<br>-<br>- | P-L-W |
| INDEPENDENT REFINING CORP (FORMERLY UNION TEXAS PETROLEUM CORP.) | WINNIE | 13,690 | 13,690 | - | - | CAT. RF.<br>HYDRO. | 6,250<br>3,000 | 5,023<br>260 | -<br>- | - |
| MARATHON OIL CO. | TEXAS CITY | 66,000 | 66,000 | - | - | CAT. CK.<br>CAT. RF.<br>ALK. | 29,030<br>8,000<br>12,800 | 14,200<br>7,300<br>10,730 | -<br>-<br>- | - |
| RIO-TEX REFINERY | HEARNE | 3,000 | 900 | 2,100 | - | - | - | - | - | - |
| MOBIL OIL CORP. | BEAUMONT | 335,000 | 335,000 | - | - | CAT. CK.<br>CAT. RF.<br>HYDRO.<br>COK.<br>ALK. | 130,030<br>92,000<br>26,000<br>24,000<br>14,129 | 48,000<br>73,000<br>26,000<br>5,000<br>14,500 | 18,000<br>-<br>-<br>-<br>5,000 | P-L-W |
| MONSANTO CHEMICAL CO | ALVIN-TEXAS CITY | 8,500 | 8,500 | - | - | - | - | - | - | - |
| PHILLIPS PETROLEUM CO. | SWEENY | 104,000 | 104,000 | - | - | CAT. CK.<br>CAT. RF.<br>ALK. | 34,030<br>34,030<br>11,400 | 19,600<br>32,000<br>9,000 | -<br>-<br>- | - |
| QUINTANA-HOWELL JOINT VENTURE[4] | CORPUS CHRISTI | 64,559 | 64,559 | - | - | - | - | - | - | - |
| SABER REFINING CO | DO | 9,950 | 9,950 | - | - | - | - | - | - | - |
| SHELL OIL CO. | DEER PARK | 294,000 | 294,000 | - | - | CAT. CK.<br>CAT. RF.<br>HYDRO.<br>THML. CK.<br>ALK. | 95,300<br>73,830<br>22,500<br>12,000<br>16,530 | 62,000<br>41,000<br>8,800<br>13,000<br>2,500 | -<br>-<br>-<br>-<br>- | A-L-W |
| SOUTH HAMPTON CO. | SILSBEE | 18,100 | 18,100 | - | - | CAT. RF. | 6,500 | 6,000 | 3,500 | - |
| SOUTHWESTERN REFINING CO. INC. | CORPUS CHRISTI | 120,000 | 120,000 | - | - | CAT. CK.<br>CAT. RF.<br>ALK. | 11,730<br>29,300<br>3,830 | 6,494<br>17,015<br>2,999 | -<br>-<br>- | - |
| SUN CO INC (FORMERLY SUN OIL CO.) | DO | 57,000 | 57,000 | - | - | CAT. CK.<br>CAT. RF.<br>COK.<br>ALK. | 18,000<br>22,430<br>6,030<br>4,000 | 10,850<br>14,600<br>1,300<br>3,100 | -<br>-<br>-<br>- | P |
| TEXACO INC. | PORT ARTHUR | 406,000 | 367,000 | 39,000 | - | CAT. CK.<br>CAT. RF.<br>HYDRO.<br>THML. CK.<br>ALK. | 135,030<br>60,030<br>15,000<br>18,000<br>17,000 | 70,000<br>50,000<br>7,500<br>7,700<br>15,000 | -<br>-<br>-<br>-<br>- | L-W |
| DO | PORT NECHES | 67,000 | 67,000 | - | - | - | - | - | - | A |
| TEXAS CITY REFINING, INC. | TEXAS CITY | 76,500 | 76,500 | - | - | CAT. CK.<br>CAT. RF.<br>THML. CK.<br>ALK. | 25,700<br>11,000<br>5,800<br>5,300 | 14,700<br>9,300<br>500<br>3,500 | -<br>-<br>-<br>- | - |
| UNION OIL CO OF CALIFORNIA | NEDERLAND | 120,000 | 120,000 | - | - | CAT. CK.<br>CAT. RF.<br>ALK. | 37,730<br>33,800<br>5,730 | 19,500<br>28,900<br>3,750 | -<br>-<br>- | A-L-W |
| UTAH | | | | | | | | | | |
| AMOCO OIL CO. | SALT LAKE CITY | 39,000 | 39,000 | - | - | CAT. CK.<br>CAT. RF.<br>ALK. | 18,000<br>6,000<br>5,300 | 10,700<br>5,400<br>3,750 | -<br>-<br>- | A |
| CARIBOU-FOUR CORNERS OIL CO. | WOODS CROSS | 7,500 | 7,500 | - | - | CAT. RF.<br>HYDRO. | 3,000<br>1,000 | 2,000<br>1,000 | -<br>- | - |
| CHEVRON U.S.A. INC (FORMERLY CHEVRON OIL CO.) | SALT LAKE CITY | 45,000 | 45,000 | - | - | CAT. CK.<br>CAT. RF.<br>COK.<br>ALK. | 16,000<br>5,000<br>7,000<br>5,500 | 9,000<br>4,400<br>1,500<br>3,500 | -<br>-<br>-<br>- | P |
| HUSKY OIL CO. | NORTH SALT LAKE | 23,000 | 23,000 | - | - | CAT. CK.<br>CAT. RF.<br>ALK. | 4,400<br>4,900<br>1,100 | 3,300<br>3,800<br>700 | -<br>-<br>- | - |
| MORRISON PETROLEUM CO. | WOODS CROSS | 2,500 | 2,500 | - | - | - | - | - | - | - |
| PHILLIPS PETROLEUM CO. | DO | 23,000 | 23,000 | - | - | CAT. CK.<br>CAT. RF.<br>ALK. | 8,000<br>4,300<br>2,000 | 6,000<br>3,400<br>1,600 | -<br>-<br>- | A |

TABLE 2. - CAPACITY OF PETROLEUM REFINERIES IN THE UNITED STATES AND PUERTO RICO: JANUARY 1, 1977 (CONTINUED)
(BARRELS PER CALENDAR DAY)

| COMPANY | LOCATION | CRUDE OIL DISTILLATION | | | | CRACKING, REFORMING, COKING, AND ALKYLATION | | | | OTHER PRODUCTS[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | OPERABLE | | | INOPERABLE SHUTDOWN[3] | TYPE OF PROCESS[1] | CHARGE | GASOLINE OUTPUT | | |
| | | TOTAL | OPERATING | SHUTDOWN | | | OPERATING AND SHUTDOWN | OPERATING | SHUTDOWN | |
| UTAH (CONT.) | | | | | | | | | | |
| PLATEAU, INC. | ROOSEVELT | 7,500 | 7,500 | - | - | CAT. CR. | 5,200 | 3,000 | - | - |
| WESTERN REFINING CO. | WOODS CROSS | 10,000 | 10,000 | - | - | - | - | - | - | - |
| VIRGINIA | | | | | | | | | | |
| AMOCO OIL CO. | YORKTOWN | 53,000 | 53,000 | - | - | CAT. CR.<br>CAT. RF.<br>COK. | 29,000<br>8,030<br>13,500 | 14,300<br>6,100<br>1,100 | -<br>-<br>- | E |
| WASHINGTON | | | | | | | | | | |
| ATLANTIC RICHFIELD CO. | FERNDALE | 96,000 | 96,000 | - | - | CAT. RF.<br>HYDRO.<br>COK. | 33,330<br>37,730<br>26,830 | 29,600<br>26,500<br>5,000 | -<br>-<br>- | E |
| CHEVRON U.S.A. INC.[10] (FORMERLY CHEVRON ASPHALT CO.) | RICHMOND BEACH | 4,500 | - | 4,500 | - | - | - | - | - | A |
| MOBIL OIL CORP. | FERNDALE | 71,500 | 71,500 | - | - | CAT. CR.<br>CAT. RF.<br>THML. CR.<br>ALK. | 25,500<br>23,400<br>7,000<br>6,892 | 12,770<br>18,400<br>-<br>5,100 | -<br>[9] 9,300<br>[9] 100<br>- | - |
| SHELL OIL CO. | ANACORTES | 91,000 | 91,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 34,050<br>19,000<br>12,600 | 22,000<br>16,000<br>11,300 | -<br>-<br>- | - |
| SOUND REFINING, INC. | TACOMA | 4,500 | 4,500 | - | - | - | - | - | - | A |
| TEXACO INC. | ANACORTES | 78,000 | 78,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 30,030<br>20,000<br>6,250 | 15,800<br>15,800<br>6,600 | -<br>-<br>- | - |
| U.S. OIL & REFINING CO. | TACOMA | 21,400 | 21,400 | - | - | CAT. RF. | 2,830 | 2,300 | - | A |
| UNITED INDEPENDENT OIL CO. | DO | 1,000 | 1,000 | - | - | - | - | - | - | - |
| WEST VIRGINIA | | | | | | | | | | |
| ELK REFINING CO., A DIVISION OF PENNZOIL CO. | FALLING ROCK | 5,500 | 5,500 | - | - | CAT. RF. | 2,030 | 2,000 | - | L-W |
| QUAKER STATE OIL REFINING CORP. | NEWELL | 9,700 | 9,700 | - | - | CAT. RF. | 3,250 | 2,660 | - | L-W |
| DO | ST MARYS | 5,000 | 5,000 | - | - | CAT. RF. | 1,450 | 1,350 | - | L-W |
| WISCONSIN | | | | | | | | | | |
| MURPHY OIL CORP. | SUPERIOR | 45,400 | 45,400 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 9,530<br>9,800<br>2,230 | 6,100<br>7,300<br>1,600 | -<br>-<br>- | A |
| WYOMING | | | | | | | | | | |
| AMOCO OIL CO. | CASPER | 43,000 | 43,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 8,930<br>5,200<br>2,030 | 5,600<br>4,420<br>1,200 | -<br>-<br>- | A-E-W |
| C & H REFINERY INC[4] | LUSK | 190 | 190 | - | - | - | - | - | - | - |
| HUSKY OIL CO. | CHEYENNE | 23,600 | 23,600 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 9,630<br>5,790<br>3,630 | 5,850<br>4,700<br>2,400 | -<br>600<br>- | A |
| DO | CODY | 10,800 | 10,800 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 3,100<br>1,430<br>1,200 | 1,850<br>1,200<br>800 | -<br>-<br>- | A |
| LITTLE AMERICA REFINING CO. | CASPER | 24,500 | 24,500 | - | - | CAT. CR.<br>CAT. RF. | 6,530<br>3,750 | 6,250<br>3,500 | -<br>- | A |
| MOUNTAINEER REFINING CO, INC. | LA BARGE | 700 | 300 | 400 | - | - | - | - | - | - |
| ORIENTAL REFINING CO.[4] | GREYBULL | 150 | - | 150 | - | - | - | - | - | - |
| SAGE CREEK REFINING CO. INC. | COWLEY | 1,200 | 1,200 | - | - | CAT. RF. | 500 | - | 500 | - |
| SINCLAIR OIL CORP (FORMERLY PASCO INC.) | SINCLAIR | 49,000 | 49,000 | - | - | CAT. CR.<br>CAT. RF.<br>ALK. | 17,250<br>9,700<br>7,600 | 9,500<br>8,400<br>2,200 | -<br>-<br>- | A |
| SOUTHWESTERN REFINING CO.[4] | LA BARGE | 500 | 500 | - | - | - | - | - | - | - |
| TESORO PETROLEUM CORP. | NEWCASTLE | 10,500 | 10,500 | - | - | CAT. CR.<br>ALK. | 3,750<br>1,200 | 2,500<br>800 | -<br>- | - |
| TEXACO INC. | CASPER | 21,000 | 21,000 | - | - | CAT. CR.<br>CAT. RF.<br>COK. | 7,030<br>6,000<br>4,030 | 6,000<br>3,400<br>2,000 | -<br>-<br>- | A-E |
| V-1 | GLENROCK | 1,000 | 100 | 900 | - | - | - | - | - | - |
| HAWAIIAN FOREIGN TRADE ZONE | | | | | | | | | | |
| HAWAIIAN INDEPENDENT REFINERY INC.[5] | EWA BEACH | 59,000 | 59,000 | - | - | CAT. RF. | 11,000 | 11,000 | - | - |
| PUERTO RICO | | | | | | | | | | |
| CARIBBEAN GULF REFINING CORP. | BAYAMON | 37,000 | 37,000 | - | - | CAT. CR.<br>CAT. RF. | 7,330<br>5,530 | 3,960<br>4,600 | -<br>- | A |
| COMMONWEALTH OIL & REFINING CO. INC. | PENUELAS | 161,000 | 132,355 | 28,645 | - | CAT. CR.<br>THML. CR.<br>ALK. | 36,030<br>20,000<br>6,630 | 10,000<br>20,000<br>4,000 | 10,000<br>-<br>1,500 | - |
| PHILLIPS PUERTO RICO CORE INC.[8] | GUAYAMA | - | - | - | - | CAT. RF. | 15,000 | 12,000 | - | - |
| SUN CO INC (FORMERLY SUN OIL CO.) | YABUCOA | 85,000 | 85,000 | - | - | - | - | - | - | L |

[1] CAT. CR. .......... CATALYTIC CRACKING
CAT. RF. .......... CATALYTIC REFORMING
HYDRO. .......... HYDROCRACKING
COK. .......... COKE.
THML. CR. .......... THERMAL CRACKING
THML. RF. .......... THERMAL REFORMING
ALK. .......... ALKYLATION

[2] OTHER PRODUCTS: A - ASPHALT; E - COKE; L - LUBRICANTS; W - WAX

[3] EQUIPMENT CONSIDERED INOPERABLE WITHOUT EXTENSIVE RECONDITIONING.

[4] CAPACITIES ESTIMATED.

[5] NOT INCLUDED WITH REFINERIES IN THE UNITED STATES BECAUSE IT IS LOCATED IN A FOREIGN TRADE ZONE.

[6] INCLUDES CRUDE OIL. SEE TABLE 3.

[7] INCLUDES 14,000 INOPERABLE SHUTDOWN.

[8] NOT COUNTED AS REFINERIES BECAUSE THEY DO NOT PROCESS CRUDE OIL.

[9] INCLUDES 10,000 INOPERABLE SHUTDOWN.

[10] ALTHOUGH THESE REFINERIES ARE NORMALLY SHUTDOWN ON JANUARY 1, THEY ARE OPERATED AT OR NEAR CAPACITY DURING THE ASPHALT PAVING SEASON.

[11] NO LONGER COUNTED AS A REFINERY SINCE CRUDE OIL DISTILLATION FACILITY HAS BEEN DISMANTLED.

# APPENDIX J

## SEPARATION AND IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM RESIDUALS

The data on separation and identification of hazardous materials in petroleum residual was obtained by surveying "Analytical Abstracts" as published since 1954.

## SEPARATION & IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM RESIDUALS

| | Determination of | Method of Analysis | Approximate Limits & Sensitivity | Matrix | Notes | Reference | Analytical Abstracts |
|---|---|---|---|---|---|---|---|
| 1 | V, Na, Ni, Ca | Spectrographic | Low PPM | Residual Fuel Oil | | Key, C, & Hoggan, G., Anal. Chem., 1953, 25 (11) 1673-1676 | 1 746 |
| 2 | Thiols | Extraction | Quan. | Petroleum Distillates | | Hopkins, C, & Smith, H., Anal. Chem., 1954, 26 (1), 206-7 | 1 1308 |
| 3 | Separation | Elution Chromatography | Quan. | Crude Oil | | Karr, C. et al, Anal. Chem., 1954, 26 (2), 252-256 | 1 1563 |
| 4 | Petroleum Sulphur Cpds. | Colorimetric | Qual. | Various | | Karr, C., Anal. Chem., 1954, 26 (3), 528-536 | 1 1896 |
| 5 | Aromatics & Unsaturates | Cryoscopic | Quan. | Kerosene & Gasoline | | Tilicheev, M. & Okinshevich, N., J. Anal. Chem., USSR, 1954, 9 (1), 3-10 | 1 2141 |
| 6 | Separation | Absorption<br>Distillation<br>U.V. | Qual. | Gas Oil | | Charlet, E. et al, Anal. Chem., 1954, 26 (5) 861-871 | 1 2141 |
| 7 | Naphthenes (Cyclohexane Type) | Dehydro-genation | 1% | Naphthas | | Polishuk, A. et al, Anal. Chem., 1954, 26, (6) 1087-89 | 1 2449 |
| 8 | $C_{18}$ to $C_{35}$ Compounds | Chromo U.V.<br>Mass Spec.<br>S Analysis | – | Heavy Gas Oil – Aromatic Portion | Alumina Gel Column Used for Separation | Lumpkin, H. and Johnson, B., Anal. Chem., 1954, 26, (11), 1719-1722 | 2 961 |
| 9 | V, Fe, Ni, Mn, Ti, Pb, Cu, Cn | Colorimetric | | Residues, Petroleum | | Sherwood, R. and Chapman, F., Anal. Chem., 1955, 27, (1) 88-93 | 2 1748 |
| 10 | Benzo (a) Pyrene | Colorimetric | .001 mg | Oil<br>High Boiling | Separated by Distillation and Alumina Column | Tye, R. et al, Anal. Chem., 1955, 27, (2), 248-253 | 2 1838 |
| 11 | Separation | Micro Distillation | 5 mill. of Sample | Oil, Crude | | Javes, A. et al, Anal. Chem., 1955, 27, (6), 991-996 | 2 3397 |
| 12 | Separation | Elution Chromo | 5 GR. Sample | Asphalt | Fullers Earth Sample | Kleinschmidt, L., J. Res. Nat. Bur. Stand, 1955, 54 (3), 163-6 | 2 3403 |
| 13 | HN =<br>Pyrole,<br>Indole, &<br>Carbazole | Infra-Red | | Oil, Diesel | | Pozefsky, A. and Kukin, I., Anal. Chem., 1955, 27, (9), 1466-1468 | 3 159 |
| 14 | Phenol | Distillation Freezing Point | | Tar, Coal | | Marx, A. and Rappen, L., Brennst Chemie, 1955, 36, (15-16), 225-228 | 3 161 |
| 15 | Anthracene,<br>Carbazole,<br>Naphthalene,<br>Phenanthrene | Infra-Red | | Tar | | Monnot, G. and Morel, P., Applied Spectroscopy, 1955, 9, (4), 180-183 | 3 1797 |
| 16 | Unsaturate Cpds. | Infra-Red | | Oils | | Zimina, K. et al., Izv. Akad. Nauk, SSR, Ser Fiz, 1954, 18, (6), 707 | 3 2785 |
| 17 | Lead | X-Ray | | Gasoline | | Ferro, A. and Galotto, C., Ann. Chem. Roma, 1955, 45, (12), 1234-1243 | 3 2788 |
| 18 | Aromatics | Cryoscopic | Quan. | Kerosene & Gasoline | Improvement of Earlier Method | Tilicheev, M. et al., Zhur. Anal. Khim, 1956, 11, (2), 188-192 | 3 3686 |
| 19 | Sulphur Cpds. | Polarography | Semi-Quan. | Crude & Fractions | | Drushel, H. and Miller, J., Anal. Chem.Acta., 1956, 15, (4), 389-393 | 4 961 |
| 20 | Sulphur | Polarography | Quan. | Crude | | Drushel, H. et al, Anal. Chem. Acta, 1956, 15, (4), 394-400 | 4 962 |
| 21 | Thiophen & 2-Methyl Thiophen | Mass. Spec.<br>I.R. | | Crude | | Thompson, C. et al, Anal. Chem., 1956, 28, (9), 1384-7 | 4 585 |
| 22 | Pyridene Bases & Phenols | Potentiometric | Quan. | Oil, Tar Middle | Non Aqueous, Solvent | Minczewski, J. and Lada, Z., Roczn. Chemie, 1955, 29, 948-950 | 4 588 |
| 23 | $C_{18}$ to $C_{25}$ Compounds | Absorption Distillation & Crystallization | | Crude | Separated into n-paraffins, branched, cyclic paraffin mononuclear aromatic trinuclear and residue | Mair, B. et al., Anal. Chem., 1957, 29 (1), 92-100 | 4 2268 |

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SEPARATION & IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM RESIDUALS (CONT'D)

| | Determination of | Method of Analysis | Approximate Limits & Sensitivity | Matrix | Notes | Reference | Analytical Abstracts | |
|---|---|---|---|---|---|---|---|---|
| 24 | 2:6-di-test-butyl-4 methyl phenol | Infra-Red | Quan. | Oil, Mineral | | Bain, G., Appl. Spectroscopy, 1956, 10 (4), 193-4 | 4 | 2270 |
| 25 | Aromatics, Mono & Di | Graphic | | Oil, Mineral | Calculation of Ring Numbers from Ref. Index, Sp. Volume & M. W. | Geslen, H. et al, J. Inst. Pet., 1957, 43, 14-20 | 4 | 3035 |
| 26 | Nitrogen Pyrrolic | Colorimetric | | Petroleum Distillated | Elution, Florisil Column | Muhs, M. and Weiss, F., Anal. Chem., 1958, 30 (2), 259-266 | 5 | 2281 |
| 27 | Thiols | Coulometric & Chromatography | Quan. | Petroleum Distillates | Celite-Silicone-Stearic Acid Column | Liberti, A. and Cartoni, G., Cheme. Ind., 1957, 39, (10), 821-4 | 5 | 2687 |
| 28 | Separation | Chromatography | Quan. | Oils | Silicone Column | Dudire, F. and Botquin, G., Anal. Chem. Acta, 1958, 18, (4), 282-90 | 6 | 248 |
| 29 | Aromatics | Phosphorescence Spectra | Quan. | Kerosene 225-300°C | Run at Liquid $N_2$ Temp. | Mamedov, K., Optica and Spektroskopiya, 1957, 3 (6), 587-591 | 6 | 1392 |
| 30 | Paraffin | Absorption & Elution | Quan. | Residues, Petroleum | Activated Charcoal | Benes, V., Chem. Prumysl, 1958, 8, (4), 191-2 | 6 | 1393 |
| 31 | Porphyrins | Colorimetric Elution | Quan. | Residues & Bitumens | | Costantinides, G., Chem. & Ind., 1959, 41 (9), 861-870 | 7 | 2826 |
| 32 | V, Fe | Spectographic | .001%,<br>± 10% | Petroleum Coke | | Vigler, M. and Conrad, A., Appl. Spectroscopy, 1959, 13, (5), 12-23 | 7 | 2827 |
| 33 | V, Fe and Ni | X-Ray | ±1 PPM | Oil | | Kang, C. et al., Anal. Chem., 1960, 32 (2), 221-5 | 7 | 4370 |
| 34 | Thiols | Mass. Spec. | | Naphthas | Up to 7 Carbons | Hoogendonk, W. and Porsche, F., Anal. Chem., 1960, 32, (8), 94-2 | 8 | 697 |
| 35 | Separation | Chromatography & Elution | | Asphalt | Alumina Column | Buchtan, J., Ropa a Uhlie, 1960, 2 (10), 268-9 | 8 | 1645 |
| 36 | Hydrocarbons, Individual | Mass. Spec. | | Oil | | Dan, T. and Oshima, S., Bull, Japan Petrol. Inst., 1960, 2, 25-32 (In English) | 8 | 2010 |
| 37 | Molecular Structure | Mass. Spec. | | Asphalt | | Clerc, R. and O'Neal, M., Anal. Chem., 1961, 33, (3), 380-2 | 8 | 4260 |
| 38 | Naphthene 5 & 6 Membered Rings | Mass. Spec. | | Petroleum | | Polyakova, A. and Khmelnitski, R., Zhur. Prilse, Khirn, 1961, 34, (7), 1569-72 | 9 | 771 |
| 39 | 1 & 2 Methyl Napthalenes | N. M. R. | Quan. | Tar | | Fujiwara, S., and Waini, T., Anal. Chem., 1961, 33, (8), 1085-7 | 9 | 767 |
| 40 | High Molecular Weight Cpds. | U. V. | Qual. | Asphaltenes | Polyethylene Discs | McDonald, F. and Cook, G., Appl. Spectroscopy, 1961, 15, (4), 110-112 | 9 | 945 |
| 41 | Aromatics | X-Ray | | Asphaltenes | | Yen, T. et al., Anal. Chem., 1961, 33, (11), 1587-1594 | 9 | 1983 |
| 42 | Octadecane Phenanthrenf Octa-Decanoic Acid | Chromotography | | Asphaltic Petroleum | Alumina Column, Efficiency | Hamway, P., Anal. Chem., 1962, 34 (1), 43-8 | 9 | 3315 |
| 43 | Metals | X-Ray | | Asphalts & Bitumens | Benzene-Ethanol Extraction | Ottemann, J. and Friesf, G., Geochim. et Cosmoch Acta, 1962, 26, 599-606 | 9 | 5197 |
| 44 | Naphthenic Acids | Colorimetric | >.05% | 170 to 230° Fraction | Spot Test | Pelcik, J., Coll. Czech. Chem. Commun, 1962, 27 (6), 1503-7 | 10 | 212 |
| 45 | Carbazoles, Phenazines, DiBenzofuran | Acid Extraction | | Petroleum | | Hartung, G. and Jewell, P., Anal. Chem. Acta, 1962, 26, (6), 514-527 | 10 | 213 |
| 46 | P | Volumetric | | Heavy Petroleum Products | | Makarov, Petal, Khim i Tekhnol, Toplir i Masal, 1963, 8 (5), 65-6 | 11 | 646 |
| 47 | Ge | Colorimetric | | Tar | | Lechner, L. and Ferenczy, Z., Nehezvegyip Kut Int. Kozlemen, 1963, 2, (3-4), 353-6 | 11 | 1813 |

SEPARATION & IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM RESIDUALS (CONT'D)

|  | Determination of | Method of Analysis | Approximate Limits & Sensitivity | Matrix | Notes | Reference | Analytical Abstracts |  |
|---|---|---|---|---|---|---|---|---|
| 48 | Perylene, Benzo, GHI Perylene Coronene | Spectroscopy, Fluorescence |  | Bitumen & Pet. Fractions |  | Ilina, A., Zavod. Lab., 1953, 29 (5), 565-7 | 11 | 2220 |
| 49 | PolyNuclear Hydrocarbon | Chromatography | Qual. | Creosote Coal Tar | Programmed Temp. | Livinsky, W. and Mason, G., J. Gas Chromatography, 1963, 1, (9), 12-16 | 11 | 4970 |
| 50 | Separation Sat'd Hycrocarbons | Chromatography | ± 1% | Heavy Petroleum | Alumina Column | Snyder, L. and Roth, W., Anal. Chem., 1964, 36, (1), 128-132 | 12 | 214 |
| 51 | Radio Activity | Radiation Absorption |  | Petroleum Products | Basic Equations & Accuracy | Balint, T., Acta. Chem. Acad. Sci. Hung., 1963, 39, (2), 161-170 | 12 | 763 |
| 52 | Metals | Neutron Activation | ± 10% | Petroleum | V, Cu, Mn, Cr, Sb, Au, Fe, Ni, Co, Zn, and Mo | Colombo, U. et al., Anal. Chem., 1964, 36, (4), 802-807 | 12 | 3989 |
| 53 | Polycyclic Aromatic Hydrocarbons | Chromatography |  | Hydrocarbons | 1, 3, 5 Trinitrobenzene Column | Tye, R. and Bell, Z., Anal. Chem., 1964, 36, (8), 1612-15 | 12 | 5930 |
| 54 | Aromatic Side-Chain Number | Mass. Spec. |  | Petroleum, High Boiling |  | Oshima, S., Bull. Chem. Soc. Japan, 1964, 37, (10), 1395-8 | 13 | 755 |
| 55 | Quinolin -2-Ones | NMR<br>Mass. Spec.<br>U. V. & I. R. | Quan. – | Crude |  | Copelin, E., Anal. Chem., 1964, 36, (12), 2274-7 | 13 | 1361 |
| 56 | TriNuclear Aromatic | Mass. Spec. |  | Petroleum Fraction |  | Lumpkin, H., Anal. Chem., 1964, 36, (13), 2399-2401 | 13 | 1855 |
| 57 | Separation | Chromatography |  | Bitumen | Gravimetric Micro | Grinberg, T. and Shyed, B., Zh. Analit. Khim., 1964, 19, (11), 1385-90 | 13 | 1859 |
| 58 | Separation | Chromatography Elution | ± .9% | 400 to 1000°F Pet. Fractions | Alumina Column<br>5 Solvents | Snyder, L., Anal. Chem., 1965, 37, (6), 713-717 | 13 | 4950 |
| 59 | Carboxylic Acids & Esters | I. R. |  | Residues, Petroleum | Occurence in Crude<br>32 Refs. | Jenkins, G., J. Inst. Petrol., 1965, 51, 313-322 | 14 | 235 |
| 60 | Alkyl Thiophens | Elution Chromatography |  | Crude | Alumina Column | Coleman, H., J. Chromat., 1965, 20, (2), 240-9 | 14 | 1565 |
| 61 | Aromatic Containing S, N, or O | Chromatography<br>Fluorescence<br>Phosphorescence |  | Petroleum Fractions | Luminescence Characteristics of 80 Aromatic Cpds. | Drushel, H. and Sommers, A., Analyt. Chem., 1966, 38, (1), 10-19 | 14 | 2636 |
| 62 | Separation | Inverse Chromatography |  | Asphalt | Fluropak Support<br>+ 10% Asphalt | Davis, T. et al., Anal. Chem., 1966, 38, (2), 241-3 | 14 | 3305 |
| 63 | Separation | Elution Chromatography<br>U.V., I.R., N.M.R. |  | Asphalts | Florosil Column | Wetmore, D., Anal. Chem., 1966, 38, (2), 225-31 | 14 | 3306 |
| 64 | Non-Thiophenic Sulphur | Potentiometric Titration | Quan. | All Petroleum Fractions |  | Lamathe, J., C. R. hebd. Seanc. Acad. Sci., Paris, C, 1966, 263, (15), 872-4 | 14 | 4797 |
| 65 | Na, K, Ca | Flame Spectro | .05 mg/litre | Oil, Fuel |  | Thomas, R., Anal. Chem., 1966, 38, (6), 785-6 | 14 | 5503 |
| 66 | Aromatic Hydrocarbons | U. V. Spectro | ± 2% | Pet. Fractions Boiling Over 180° |  | Balint, T., Acta. Chim. Hung., 1966, 48, (3), 261-77 | 14 | 6919 |
| 67 | Polynuclear Aromatic Hydrocarbons & Heterocyclics | Chromatography |  | Coal, Tar | Temp. Programmed on Inorganic Salts Column | Sauerland, H. and Zander, M. Erdol Kohle. 1966 19, (7), 502 - 5 |  |  |
| 68 | AR | Neutron Activation | 1 PPB | Crude Oil |  | Veal, D., Anal. Chem., 1966, 38, (8), 1080-3 | 14 | 6922 |
| 69 | Carcinogenic Hydrocarbons | Thin Layer Chromatography |  | Paraffins & Waxes |  | Woggon, H. and Jehle, D., Plaste, Kautsch., 1966, 13, (8), 460-2 | 14 | 7568 |

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## SEPARATION & IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM RESIDUALS (CONT'D)

| | Determination of | Method of Analysis | Approximate Limits & Sensitivity | Matrix | Notes | Reference | Analytical Abstracts | |
|---|---|---|---|---|---|---|---|---|
| 70 | Thiaindanes | Chromatography I. R. | | Crude Oil | | Thompson, C., Anal. Chem., 1966, 38, (11), 1562-6 | 15 | 286 |
| 71 | Organo Metallics | Mass. Spec. | | Oil | | St. George, B. and Zakail, D., Can. Spectrosc, 1966, 11, (5), 133-6 | 15 | 834 |
| 72 | Cyclic Aromatic Hydrocarbons | Elution Chromatography | | Oil | | Liebisch, L. and Eckardt, H., Z. Chemie, LPz., 1966, 6, (10), 377-8 | 15 | 838 |
| 73 | Asphaltenes | Gravimetric | Quan. | Crude Oil | | Neumann, H. et al., Brennst Chem., 1967, 48, (3), 66-9 | 15 | 3413 |
| 74 | Ni, V | Spectrographic | Ni .1 to 8 PPM<br>V .9 to 67 PPM | Residuals | | Manoliu, C. and Pasculescu, M., Revta. Chim., 1967, 18, (3), 180-2 | 15 | 3416 |
| 75 | Separation of Hydrocarbons | Elution Chromatography | | Oil | Column with Spehade × LH 20 | Mair, B. et al., Anal. Chem., 1967, 39, (7), 838-40 | 15 | 5410 |
| 76 | Naphthalene Derivatives | Chromatography | | Pet. Fractions 180-280° | | Szynagel, P. and Jedrychowska, M., Chemia. Analit., 1967, 12, (4), 733-86 | 15 | 6101 |
| 77 | Benzene | U. V. | .01 mg/ml | Pet. Fractions | | Przybylski, Z., Chemia. Analit., 1967, 12, (4), 633-74 | 15 | 6102 |
| 78 | Fe, Sb, Se, Cr, Ag, Sc, Co, Zn | Neutron Activation | 85 to 90% | Crude Oil | | Patek, P. and Bildstein, H., Z. Analyt. Chem., 1967, 231, (3), 187-92 | 15 | 7372 |
| 79 | 72 Elements | Neutron Activation | | Refined Hydrocarbon | | Yule, H., Nucl. Applics., 1967, 3, 637-40 | 16 | 758 |
| 80 | Alicyclic Rings | NMR | | Oil | | Knight, S., Chemy. Ind., 1967, (45), 1920-23 | 16 | 763 |
| 81 | Group Analysis | Mass. Spec. | | Pet. Fractions 260-510 | No Prelim. Separation | Gallegos, E., Anal. Chem., 1967, 39, (14), 1833-8 | 16 | 1357 |
| 82 | Separation | Elution Chromatography | ± .5% | Heavy Petroleum | *Copy on Hand | Middleton, W., Anal. Chem., 1967, 39, (14), 1839-46 | 16 | 1360 |
| 83 | Sulphoxides | Cation Exchange Resin Chromatography | | Pet. Fraction 250-500°C | | Okuno, I. et al., Anal. Chem., 1967, 39, (14), 1830-33 | 16 | 1362 |
| 84 | Separation | Elution Chromatography | | Pet. Fraction | Separates Iso-alkanes Napthenes, aromatics, & resinous cpds. | Triems, K. and Heinze, G., Chem. Tech. Bel, 1968, 20, (1), 40-2 | 16 | 2556 |
| 85 | Polycyclic Hydrocarbons | T. L. C. | | Hydrocarbon Mixtures | Chrysene, dibenzanthrone, benzypyrene, benzanthrone, pyrene, fluoranthene, anthracene, & Perylane | Kelenffy, S., Egesysegtudomany, 1968, 12, (2), 125-8 | 17 | 291 |
| 86 | Separation | GC NMR LC Mass Spec. | | Crude Oil | Light Fractions Mainly | Boulet, R. et al., Revue Inst. fr. Petrole, 1968, 23, (3), 315-39 | 17 | 936 |
| 87 | Nitrogen & Oxygen Cpds. | Mass. Spec. IR, UV | | Pet. Fraction 700-850°F | Separation and Identification | Snyder, L. et al., Anal. Chem., 1968, 40, (8), 1303-17 | 17 | 2217 |
| 88 | Aromatics | U.V. Near I. R. | | Aromatic Mixtures | | Schmidt, H., Erdol. Kohle, 1968, 21 (6), 334-40 | 17 | 2806 |
| 89 | Carcinogenic Polycyclic Hydrocarbons | Fluor. Phos. | .1 ug | Hydrocarbon Mixtures | 8 Carcinogenics | Hood, L. and Winefordner, D., Analytica Chim. Acta, 1968, 42, (2), 199-205 | 17 | 3553 |
| 90 | Polycyclic Hydrocarbons | Fluor. | | Pet. Fractions | Relationship of Fluorescence to Structure | Yanbastiev, M., C. r. Acad. bulg. Sc., 1968, 21, (8), 805-8 | 18 | 304 |
| 91 | Separation | Elution Chromo | | Hydrocarbons Mixture | To $C^{60}$ Using Perfluorocyclic Ethers | Snyder, L., J. Chromat., 1968, 36, (4), 476-88 | 18 | 653 |
| 92 | Polycyclic Aromatics | G. C. | | Hydrocarbons Mixtures | Carbon-Black Column | Zane, A., J. Chromat., 1968, 38, (1), 130-3 | 18 | 1747 |
| 93 | Hydrocarbons | Mass. Spec. | | Hydrocarbon Mixtures | | Srob, V., Nafta Zagr., 1968, 19, (12), 549-55 | 18 | 2538 |

Dwg. 2618C55

SEPARATION & IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM RESIDUALS (CONT'D)

| | Determination of | Method of Analysis | Approximate Limits & Sensitivity | Matrix | Notes | Reference | Analytical Abstracts | |
|---|---|---|---|---|---|---|---|---|
| 94 | Polynuclear Hydrocarbons | T. L. C. | | Hydrocarbon Mixtures | Two Dimensional Dual Band | Matsushita, H., Bull Chem. Soc. Japan, 1969, 42, (2), 460-4 | 18 | 4139 |
| 95 | Asphaltenes | EPR | | Petroleum | | Bazhenov, V. et al., Zar. Lab, 1969, 35, (2), 182-3 | 18 | 4146 |
| 96 | Ni | A. A.<br>Fluor. | .01 PPM | Heavy Pet. Fractions | | Sychra, V. et al., Chemicke. Listy, 1969, 63, (2), 177-84 | 18 | 4153 |
| 97 | Separation | Gel Permeation Chromatography | | Crude Oil | Polystyrene Gel | Coleman, H., Anal. Chem., 1969, 41, (6), 800-804 | 19 | 1431 |
| 98 | Nitrogen & Oxygen Cpds. | Chromo. | | Pet. Fractions 850-1000°F | | Snyder, L., Anal. Chem., 1969, 41, (8), 1084-1094 | 19 | 2344 |
| 99 | Separation | Reverse Phase Chromo. | | Asphalt | | Helm, R., Anal. Chem., 1969, 41, (10), 1342-1344 | 19 | 3154 |
| 100 | Separation | Reverse Phase Chromo. | | Asphalt | Silylation | Dorrence, S. and Petersen, J., Analyt. Chem., 1969, 41, (10), 1240-3 | 19 | 3155 |
| 101 | Carboxylic Acids | Chromo. I. R.<br>U. V. Mass. Spec. | | Crude Oil | | Seifert, W., Anal. Chem., 1969, 41, (12), 1638-47 | 19 | 4038 |
| 102 | Separation | Mass. Spec. | | Aromatic Fraction | Expressed in terms of 12 hydrocarbon type, 3 thiophen types & 6 unidentified groups | Robinson, C. and Cook, G., Anal. Chem., 1969, 41, (12), 1548-54 | 19 | 4039 |
| 103 | Separation | Laser Pyrolysis Chromo. | - | Petroleum Products | | Folmer, O. and Azoraga, L., J. Chromat. Sci., 1969, 7, (11), 665-70 | 19 | 4043 |
| 104 | Separation & Analysis | U. V. Mass. Spec. | | Heavy Oils | Procedure for complete analysis | Fitzgerald, M., Appl. Spectrosc, 1970, 24, (1), 106-114 | 20 | 282 |
| 105 | Alkyl Benzo (b) Thiophens | Chromo.<br>Spectro | | Pet. Fraction 200-250°C | | Hopkins, R. et al., Anal. Chem., 1969, 41, (4), 2041-46 | 20 | 285 |
| 106 | Separation | Chromo.<br>Capillary | | Tar | 55 Cpds. Identified | Pichler, H. et al., Erdoel. Kohle Brennst.Chem., 1970, 23, (2), 91-4 | 20 | 1764 |
| 107 | Separation | Mass. Spec. | | Pet. Fractions <1100°F | Computer Programs | Aczel, T., Anal. Chem., 1970, 42, (3), 341-7 | 20 | 2517 |
| 108 | Separation | G. P. C. | | Asphalts | | Bynum, D. et al., J. Inst. Petrol, 1970, 56, 147-154 | 20 | 3107 |
| 109 | Polycyclic Aromatic Carboxylic Acids Na, S, Cl, K | Chromo<br>Mass. Spec. | | Crude Oil | | Seifert, W. and Teeter, R., Anal. Chem., 1970, 42, (7), 750-8 | 20 | 3969 |
| 110 | Ca, V, Mn, Cu, Ga, & Br | Neutron Activation | .35 to 46 PPM (except S) | Petroleum | | Shah, K. et al., J. Radioanalyt. Chem., 1970, 6, (1), 185-192 | 21 | 1230 |
| 111 | Structural Parameters | Integrated Structural Analysis | | Petroleum Heavy Ends | Math. Technique | Hirsch, E. and Altgelt, K., Anal. Chem., 1970, 42, (12), 1330-9 | 21 | 1883 |
| 112 | Separation | Chromo. | | Hydrocarbon Mixtures | to $C_{60}$ | Novotny, M. et al., Anal. Chem., 1972, 44, (1), 9-13 | 23 | 2095 |
| 113 | Separation | Elution Chromo | | Pet. Fraction High Boiling | Double Packed Column | Hirsch, D. et al., Anal. Chem., 1972, 44, (6), 945-9 | 23 | 4661 |
| 114 | Polycyclic Aromatic Hydrocarbons | Chromo<br>Spectrophot. | | Hydrocarbon Mixtures | | Ives, F. and Giuffridn, L., J. Ass. off. Anal. Chem., 1977, 55, (4), 757-761 | 24 | 891 |
| 115 | Separation | Ion Exchange Chromo Mass. Spec. | | Heavy End Petroleum Distillates | | Jewell, D. et al., Anal. Chem., 1972, 44, (8), 1391-5 | 24 | 903 |
| 116 | Acidic Cpds. | Ion Exchange Chromo | | High Boiling Pet. Distillates | | McKay, J. et al., Sepn. Sci., 1972, 7, (4), 361-370 | 24 | 904 |
| 117 | Pb | A. A. | .002 ng | Petroleum | Carbon Rod Atomizer | Bratzel, M. and Chakrabosti C., Analytic Chem. Acta., 1972, 61, (1), 25-32 | 24 | 1659 |
| 118 | Polycyclic Aromatic Hydrocarbons | Liquid Chrom. | | Hydrocarbon Mixtures | | Martin, M. et al., Chromatographia, 1972, 5, (1), 33-41 | 24 | 1662 |

Dwg. 2618C56

## SEPARATION & IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM RESIDUALS (CONT'D)

| | Determination of | Method of Analysis | Approximate Limits & Sensitivity | Matrix | Notes | Reference | Analytical Abstracts | |
|---|---|---|---|---|---|---|---|---|
| 119 | Aromatics | Fluorescence | | Pet. Distillate 400-500 °C | Separation & Identification | McKay, D. and Latham, D., Anal. Chem., 1972, 44, (13), 2132-7 | 24 | 3551 |
| 120 | Polycyclic Aromatic Hydrocarbons | Chromo. Mass. Spec. | | Oil Mineral | | Gilchrist, C. et al., Analyst Lond.., 1972, 97, 880-8 | 24 | 3554 |
| 121 | Aromatic Hydrocarbons | Elution Chromo. | | Pet. Residues | Mono, Bi, & Polycyclic Separated | Jewell, D. et al., Anal. Chem., 1972, 44, (14), 2318-2321 | 25 | 950 |
| 122 | Polycyclic Aromatic Hydrocarbons | Liquid Chrom. | | Hydrocarbon Mixtures | Pressure | Loheac, J. et al., Analusis, 1973, 2, (3), 168-175 | 25 | 2352 |
| 123 | Separation | Elution Chromo. | | Bitumen | | Zalka, L. et al., Acta. Chim. Hung, 1973, 76, (2), 121-165 | 25 | 2364 |
| 124 | Fused Ring Aromatic Hydrocarbons | Liquid Chrom. | 2 ng. | Hydrocarbon Mixtures | | Strubert, W., Chromatographia, 1973, 6, (4), 205-6 | 25 | 3164 |
| 125 | Polycyclic Aromatic Hydrocarbons | Elution Chromo. | | Hydrocarbon Mixtures | Organic Gel Columns Separates benzo(a) pyrene from benzo(e) pyrene | Klimisch, H. and Reese, D., J. Chromat, 1973, 80, (2), 266-70 | 26 | 230 |
| 126 | Polycyclic Aromatic Hydrocarbons | Gel Per Chromo. Fluor. Spec. | – | Petroleum | Separation and Identification | McKay, J. and Latham, D., Anal Chem., 1973, 45, (7), 1050-5 | 26 | 240 |
| 127 | Alkenes & Naphthenes | Pattern Ident. Mass Spec. | | Petroleum | | Khots, M., Zh. Analit. Khim., 1973, 28, (4), 797-801 | 26 | 944 |
| 128 | Polycyclic Hydrocarbons | T. L. C. Fluor. | 310 ug/kg | Residual Oils | DMSO Extraction | Matsushita, H., Japan Analyst, 1972, 21, (3), 331-7 | 26 | 945 |
| 129 | Separation | Iom Exc. Chrom. Mass. Spec. | | Pet. Distillate 370-535° | (*Copy of Report on Hand) | Dooley, J. et al., Rep. Invest., U. S. Bur. Mines, R1770, 1973, 28 pp | 26 | 1594 |
| 130 | V | A. A., Fluor Carbon Fil. | 1 PPM | Oil, Fuel | | Everett, G. et al., Analytica Chim. Acta, 1973, 66, (2), 301-3 | 26 | 3317 |
| 131 | Separation | Elution Chromo. | | Pet. Bitumen | | Kolbin, M. et al., Khimija Tekhnol. Topl. Masel., 1973, (1), 48-51 | 27 | 184 |
| 132 | Separation | G. C. High Temp. | | Pet. Residues | | Levy, E. et al., J. Chromat. Sci., 1973, 11, (11), 591-3 | 27 | 185 |
| 133 | Separation | Steam Dist. & G. C. | | Tar | | Klesment, I., J. Chromat., 1973, 87, (2), 401-9 | 27 | 771 |
| 134 | Metals | Various | | Oil, Fuel | Comparison of det. of 28 elements by various methods & Labs. | Lehmden, D., et al., Anal. Chem., 1974, 46, (2), 239-45 | 27 | 1373 |
| 135 | Separation | Elution Chromo. | | Petroleum Products | Elution Properties of Various Solvents | Kolbin, M., Zav. Lab., 1974, 40, (2), 157-8 | 27 | 1431 |
| 136 | Characterization | I. R. & Statistical Discriminant Function Anal. | | Asphalts & Res. Fuel Oils | (*Copy of Report on Hand) | Kawahara, F. et al., Anal. Chem., 1974, 46, (2), 266-73 | 27 | 1434 |
| 137 | Napthens | L. C. Mass. Spec. | | Pet. Fractions 99 to 150 °C | | Abo-Lemon, F. and Guichard, N., Analytica Chem. Acta., 1974, 68, (2), 484-7 | 27 | 2002 |
| 138 | Cu, Pb, As | Spectrographic | .01 part/$10^9$ for Cu<br>.5 part/$10^9$ for Pb<br>1 part/$10^9$ for As | Petroleum | | Shmulyakovskii, Y. et al., Khimiya. Tekhnol. Topl. Masel., 1973, (4), 55-9 | 27 | 2648 |
| 139 | Polycyclic Aromatic Hydrocarbons | Luminescence Spectrom. | .1 µm | Hydrocarbon Mixtures | Run @ 77 °K Shpol'skii Effect | Kirkbright, G. and Lima, C., Analyst. Land., 1974, 99, (1179), 338-54 | 28 | 1549 |

Dwg. 2618C57

SEPARATION & IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM RESIDUALS (CONT'D)

| | Determination of | Method of Analysis | Approximate Limits & Sensitivity | Matrix | Notes | Reference | Analytical Abstracts | |
|---|---|---|---|---|---|---|---|---|
| 140 | Separation | Gel Permeation Chromo | | Pet. Fractions High Boiling | Retention Volume data for 62 cpds. | Hirsch, D. et al., Ref. Invest. U. S. Bur. Mines, R17875, 1974 | 28 | 1C69 |
| 141 | Metals | A. A. | 1 part in $10^9$ to 5 PPM | Petroleum Products | 23 Elements | Vigler, M. and Gaylor, V., Appl. Spectrosc., 1974, 28, (4), 342-4 | 28 | 2547 |
| 142 | Phenols & Hydrocarbons | Gel Chromo. | | Hydrocarbon Mixtures | Elution data for 27 hydrocarbons & 80 phenols | Coupek, J. et al., J. Chromat, 1974, 95, (1), 103-112 | 28 | 3C27 |
| 143 | Polycyclic Aromatic Hydrocarbons | Gel Chromo. | | Hydrocarbon Mixtures | | Klimisch, H. and Ambrosius, D., J. Chromat, 1974, 94, (3), 11-2 | 28 | 3C35 |
| 144 | Pyridine Bases | Ion Exchange | | Aromatic Hydrocarbons | | Niedzielska, K. and Slowik, A., Chem. Analit., 1974, 19, (4), 787-793 | 28 | 3C38 |
| 145 | Benz(a)pyrene | Elution Chromo U.V. Fluor | .1 PPM | Pet. Residues | | Popl, M. et al., Anal. Chem., 1974, 46, (11), 1581-2 | 28 | 3C47 |
| 146 | Petroleum Group Types | Mass. Spec. | Quan. | High Boiling Pet. | | Fisher, I. and Fischer, P., Talanta. 1974, 21, (8), 867-75 | 28 | 4C38 |
| 147 | Polycyclic Aromatics | Elution Chromo U.V. | Quan. | Gas, Oil | | Mukmerjee, P. and Sinha, A., Technology, Sindn., 1973, 10, (3-4), 279-80 | 28 | 5C52 |
| 148 | Unsat. Hydrocarbons | Elution Chromo | – | Hydrocarbon Mixtures | Thallium Tetraphenylborate Column | Baiulescu, G. and Ilie, V., Anal. Chem., 1974, 46, (12), 1847-9 | 28 | 6C15 |
| 149 | $H_2S$ | Ion Electron | | Petrol. Fractions | Cadmium Ion Specific Electrode | Rousseau, J., Analusis, 1973-1974, 2 (10-11), 718-21 | 28 | 6C60 |
| 150 | 2. Furaldehyde | G. C. Spectroph. | | Oil, Gas | | Lidzey, R. and Stockwell, P., Analyst, Lond., 1974, 99, (1184), 749-54 | 28 | 6C61 |
| 151 | Polycyclic Aromatic Hydrocarbons | Paper Chromo Fluor. | 6 ng. | Hydrocarbon Mixtures | | D'Arrigo, V. and Cavana, M., Rass. Chim., 1974, 26, (4), 169-82 | 29 | 1C54 |
| 152 | Paraffin & Naphthenes | G. C. | | Hydrocarbon Distillates | Mol. Sieve 13-X | Soulages, N. and Brieva, A., J. Chromat., 1974, 101, (2), 365-71 | 29 | 1C64 |
| 153 | Aromatic Hydrocarbons | Elution Chromo | | Hydrocarbon Mixtures | | Popl, J. et al., J. Chromat., 1975, 104, (1), 135-9 | 29 | 2C43 |
| 154 | Sulpholan | Elution Chromo | ± 20% | Pet. Hydrocarbons | | Turgel, E. et al., Zh. Analit. Khim., 1974, 29, (6), 1242-3 | 29 | 2C63 |
| 155 | Dicarboxylic Annydrides | I. R. | | Asphalt | | Petersen, J., Anal. Chem., 1975, 47, (1), 107-11 | 29 | 2C64 |
| 156 | Carhonyl Cpds. | Diff I. R. | | Asphalt | | Petersen, J. Anal. Chem., 1975, 47, (1), 112-117 | 29 | 2C65 |
| 157 | Separation | Gel Per. Chrom. Mass. Spec. | | Pet. Fractions 390-535° | Retention Tables, etc. | Hirsch, D. et al., Rep. Invest. U. S. Bur. Mines, RI 7974, 1974 | 29 | 3C43 |
| 158 | Alkanes, Isoprenoid | G. C. | | Petroleum | | Shlyakhov, A. et al., J. Chromat, 1975, 104, (2), 337-9 | 29 | 3C44 |
| 159 | Polycyclic Hydrocarbons | Liquid Chrom. | | Oil, Mineral | 2 Columns, U. V. | Berthold, I., Erdoel Kohle Erdgas Petroleum, Brennst. – Chem., 1975, 28, (2), 93 | 29 | 4C56 |
| 160 | Polycyclic Aromatic Hydrocarbons | Fluor. Phosphor. | .1 ng/ml for benz(a)pyrene | Hydrocarbon Mixtures | | Gaevaya, T. and Khesina, A., Zh. Analit. Khim, 1974, 29, (11), 2275-31 | 29 | 5C54 |
| 161 | Sample Types | G. C. Pattern Recognition | 87 to 100% Success | Petroleum | | Clark, H. and Jur, P., Anal. Chem., 1975, 47, (3), 374-8 | 29 | 5C61 |
| 162 | Naphthenics | I. R. | Qual. | Oil, Mineral | | Berthold, P. and Staude, B., Chemia. Analit., 1975, 20, (2), 275-92 | 29 | 5C63 |
| 163 | Polynuclear Hydrocarbons | Liquid Chrom | 10 to 100 pg | Oils | Chemically Modified Column | Wheals, B. et al., J. Chromat., 1975, 106, (1), 109-18 | 29 | 5C65 |

## SEPARATION & IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM RESIDUALS (CONT'D)

| | Determination of | Method of Analysis | Approximate Limits & Sensitivity | Matrix | Notes | Reference | Analytical Abstracts |
|---|---|---|---|---|---|---|---|
| 164 | Polynuclear Aromatic Hydrocarbons | G. C. | | Oils | | Lee, M. et al., Anal. Chem., 1975, 47, (3), 540-3 | 29 5C66 |
| 165 | Polycyclic Hydrocarbons | Spectro Fluorimetric | | Petroleum & Tar | DMSO as Solvent | Matsusheta, H. and Avashidani, K., Bunseki Kagaku, 1975, 24, (3), 198-201 | 29 5H31 |
| 166 | Polycyclic Aromatic Hydrocarbons | Liquid Chrom | | Hydrocarbon Mixtures | '3-(2,4,5,7-Tetranitro-9-Fluorenylidenamino)-Propyldiethoxysiloxane' Column | Lochmueller, C. and Amoss, C., J. Chromat., 1975, 108, (1), 85-93 | 30 1C47 |
| 167 | Organic Sulphides | Elution Chrom | | Pet. Fractions High Boiling | | Vogh, J. and Dooley, J., Anal. Chem., 1975, 47, (6), 816-21 | 30 1C56 |
| 168 | Aromatics & Heterocyclics | Spot Tests | Qual. | | Color for 44 aromatics & 18 heterocyclics | Heacock, R. and Hutzinger, O., Mikrochim. Acta., 1975, II, (1), 104-8 | 30 2C29 |
| 169 | Benzo(a)pyrene | Fluor. | | Wax, Petroleum | DMSO as Solvent | Shiraishi, Y. and Takabataka, E., Eisei Kagaku, 1975, 21, (2), 65 | 30 2C62 |
| 170 | Metals | A. A. | | Petroleum | Coated Graphite Furnace | Runnels, J. et al., Anal. Chem., 1975, 47 (8) 1258-1263<br>" " 1269-1275<br>" " 1263-1268 | 30 3C42<br>3C43<br>3C44 |
| 171 | Separation | Liquid Chrom | | Petroleum | | Suatoni, J. and Swab, R., J. Chromat Sci., 1975, 13, (8), 361-6 | 30 3C48 |
| 172 | Polycyclic Aromatic Hydrocarbons | Ion Exchange Liquid Chrom | – | Petroleum Aromatics | Seperate mono, di, tri, and polycyclics | Jewell, D., Analyt. Chem., 1975, 47, (12), 2048-50 | 30 6C62 |
| 173 | Polycyclic Aromatic Hydrocarbons | Elution Chromo. | | White Petroleum Products | | Popl, M. et al., Anal. Chem., 1975, 47, (12), 1947-50 | 30 6C63 |
| 174 | Be | A. A. | 1 PPB | Petroleum | | Robbins, W. et al., Anal. Chem., 1975, 47, (13), 2095-2101 | 30 6C64 |
| 175 | Metals | A. A. | | Petroleum Cokes | | Serbanescu, A. et al., Revta Chim., 1975, 26, (10), 863-9 | 30 6C65 |
| 176 | Aromatics | Ion Exchange | | Hydrocarbon Mixtures | Dowex 1-X8 and Aminex A-28 Resins | Jahangir, L. et al., Talanta, 1975, 22, (12), 979-987 | 31 1C25 |
| 177 | Hydrocarbons | Mass. Spec.<br>G. C.<br>Mol. Sieve | | Fuel, Diesel | Separation and Identification | Herlan, A., Erdoel. Kohle Edgas Petrochem Brennst-Chem, 1976, 29, (1), 32 | 31 1C39 |
| 178 | Polycyclic Aromatic Hydrocarbons | Elution Chrom, G. C. | | Oil, Lubricating | | Grimmer, G. and Bohnke, H., Erdoel Kohle Edgas, Petrochem Brennst-Chem, 1975, 28, (12), 569 | 31 1C42 |
| 179 | Fe, V | Amperometric | | Coke, Petroleum | | Ratovskava, A. et al., Trudy Ufim. Neft. Inst., 1974, (16), 212-4 | 31 1C45 |
| 180 | Polycyclic Aromatic Hydrocarbons | Elution Chrom. G. C. | 1 to 100 ppm | Waxes, Raffinates, Lub Oils | | Grimmer, G. and Bohnke, H., Chromatographia, 1976, 9, (1), 30-40 | 31 2C70 |
| 181 | Separation | Silica Gel Absorption on | | Hydrocarbon Mixtures | Retention Indices for 113 Aromatic Hyd. | Popl, M. et al., J. Chromat., 1976, 117, (1), 117-27 | 31 3C33 |
| 182 | Separation | G. C. | | Petroleum | Simulated Distillation | Jackson, B. et al., J. Chromat Sci., 1976, 14, (2), 49-51 | 31 3C44 |
| 183 | Benzo(a)pyrene | T. L. C. Fluor | | Tar Pitch | Specific | Matsushita, H. et al., Japan Analyst, 1976, 25, (2) 76-80 | 31 3C51 |
| 184 | Polycyclic Aromatic Hydrocarbons | Gel Chrom | | Hydrocarbon Mixtures | Bio-Beads SX-12 column 19 Cpds. Investigated | Snook, M., Analytica Chim. Acta., 1976, 81, (2), 423-27 | 31 3D66 |
| 185 | Polycyclic Aromatic Cpds. (Biogenic) | T. L. C. Fluor. | Qual. | Various | Ident. by Intensities @ 360 and 445 nm | Hellmann, H., Z. Analyt. Chem., 1976, 278, (4), 263-8 | 31 3H32 |
| 186 | Polycyclic Hyd. | G. C. | | Aromatic Hydrocarbon Mixtures | Cadmium Chloride – Carbowax 20 M Column | Guha, O. and Bhaumik, A., J. Chromat., 1976, 119, 181-6 | 31 4C59 |

## SEPARATION & IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM RESIDUALS (CONT'D)

| | Determination of | Method of Analysis | Approximate Limits & Sensitivity | Matrix | Notes | Reference | Analytical Abstr cts |
|---|---|---|---|---|---|---|---|
| 187 | Separation | Elution Chromat | | Aromatic Hydrocarbon Mixtures | Sep. of Polycyclic Hyd. & N-heteropolycyclic cpd. Kieselgel - $AGNO_3$ | Klimisch, H. and Fox, K., J. Chromat, 1976, 120, (2), 482-4 | 31 5C55 |
| 188 | Polycyclic Aromatic Hydrocarbon | Luminescence Spectrometry | nM | Hydrocarbon Mixtures | Shpol' skii Effect at 77 °K II Equipment | Causey, B. et al., Analyst., Lond., 1976, 101, (1202), 367-8 | 31 5C52 |
| 189 | Separation | "Group" Mass. Spec. | | Petroleum | | Brodskii, E. and Golburg, V., Zh. Analit. Khim., 1976, 31, (3), 565-71 | 31 5C59 |
| 190 | N, Fl, S. Pb | Activation Analysis | 5 to 50 ng/g | Petroleum | | Gosset, J. et al., Analusis, 1976, 4, (4), 161-8 | 31 5C62 |
| 191 | Nitrogen Bases | Elution Chromo. Kjeldahl | | High Boiling Pet. Fractions | | McKay, J. et al., Anal. Chem., 1976, 48, (6), 891-8 | 31 6C53 |
| 192 | Fe, Ni | A. A. Activation | | Asphalt | Comp. of Results from both Techniques | May, L. and Presly, B., Analytica. Chim. Acta., 1976, 83, 385-8 | 31 6H44 |
| 193 | V | Electron Spin Resonance | .55 ug | Pet. Fractions | | Nikishenko, S. et al., Zh. Analit. Khim., 1976, 31, (6), 1210-12 | 32 1C40 |
| 194 | Ni | A. A. | | Petroleum | Uses 8 different Nickel cpds. | Lang, I. et al., Analytica Chim. Acta, 1976, 84, (2), 299-305 | 32 1C41 |
| 195 | Aromatic Hydrocarbons | FAR U. V. | – | Kerosine | | Chereonichenko, V. et al., Trudy Grozn. neft. nauchnoissled Inst., 1975, (29), 135-140 | 32 1C42 |
| 196 | Separation | Elution Chrom. | | Residues | Complete Separation Procedure | Oelert, H. and Neumann, H., Erdoel Kohle Erdgas Petrochem Brennst-Chem., 1976, 29, (7), 309 | 32 1C43 |
| 197 | Nitrogen & Oxygen Cpds. | Mass. Spec. | | Petroleum | | Peters, A. and Bendoraitis, J., Anal. Chem., 1976, 48, (7), 968-73 | 32 1C44 |
| 198 | Polycyclic Aromatic Hydrocarbons | Luminescence Spectrometry | .1 to $1^0$µm | Hydrocarbon Mixtures | Shpol' skii Effect @ 77 °K III Luminescence Excitation spectra | Farooq, R. and Kirkaright, G., Analyst, Lond., 1976, 101, (1204), 566-73 | 32 2C43 |
| 199 | Separation & Ident. | Chromo. | | Petroleum Products | Elementary Composition | Fadew, V. et al., Trudy grozn. neft. nauchno-issled. Inst., 1975, (29), 66-8 | 32 2C49 |
| 200 | Separation | Chromo. | | Hydrocarbons | $Zr(KPO_4)_2$ and $Zr(KA_5O_4)_2$ Columns | Allulli, S. et al., Anal. Chem., 1976, 48, (8), 1259-61 | 32 2J21 |
| 201 | Separation | Elution Chrom. Gel. P. Chrom. I. R. | | Oil, Heavy 350-700 | U. S. Bur. Mines-A. P. I. Scheme for Char. of Heavy Oils Extension of | Haines, W., Erdoel Kohle Erdgas Petrochem Brennst-Chem., 1976, 29, (8), 363 | 32 3C40 |
| 202 | Aromatic Hydrocarbons | Colorimetry | .2 to 600 mg/l | Refinery Wastes | | Usbonski, J. and Supeson, A., Chemia. Analit., 1976, 21, (4), 955-61 | 32 3C44 |
| 203 | Polycyclic Aromatic Hydrocarbons | I. R., G. C. H. P. L. C. & U. V. | | Hydrocarbon Mixture | | Halloman, H., Z. Analyt. Chem., 1976, 281, (2), 125-9 | 32 4C34 |
| 204 | Aromatic Hydrocarbons | Raman Spectros. | | Hydrocarbon Mixture | | Garrard, D. and Maddamo, W., Appl. Sepctrosc., 1976, 30, (5), 554-5 | 32 4C35 |
| 205 | Aromatic Hydrocarbons | Liquid Chrom. Ion Exchange | | Hydrocarbon Mixtures | Polystyrene Resins Mixed Solvents | Ordemann, D. and Walton, H., Analyt. Chem., 1976, 48, (12), 1728-31 | 32 5C41 |
| 206 | Polycyclic Aromatic Hydrocarbons | Partition Chromo. | 10 - 100 ug/kg | Mineral Oil | | Kaschani, D., Endoel Kohle Erdgas Petrochem. Brennst-Chem., 1976, 26, (11), 514 | 32 5C49 |
| 207 | Separation Preparative | L. C. | | Hydrocarbons Boiling > 270° | Bio-Sil A Column | Suatoni J. and Swab, R., J. Chromat. Sci., 1976, 14, (11), 535-7 | 32 6C38 |
| 208 | Separation | L. C. | | Hydrocarbons 190-360 | L. Chromosorb | Suatoni, J. and Garber, H., J. Chromat. Sci., 1976, 14, (11), 546-8 | 32 6C39 |
| 209 | Aromatic Hydrocarbons | G. C. | | Hydrocarbon Mixture | Silver Nitrate Column Retention Times for 14 Cpds. | Wasik, S. and Brown, R., Anal. Chem., 1976, 48, (14), 2218-20 | 33 1C23 |
| 210 | Polycyclic Aromatic Hydrocarbons | G. C. Mass. Spec. | Benzo (a) Pyrene 4 ng | Hydrocarbon Mixtures | Liquid Crystal Columns | Janini, G. et al., Anal. Chem., 1976, 48, (13), 1879-83 | 33 1C42 |

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SEPARATION & IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM RESIDUALS (CONT'D)

| | Determination of | Method of Analysis | Approximate Limits & Sensitivity | Matrix | Notes | Reference | Analytical Abstracts |
|---|---|---|---|---|---|---|---|
| 211 | Selenium | A. A. | 10 ng/g | Petroleum | | Walker, H. et al., Anal. Chem., 1976, 48, (14), 2056-60 | 33 1C49 |
| 212 | Pyridine Bases | Spectrophotometry | | Coal, Tar | | Zalewski, R. et al., Chem. Anal., 1976, 21, (6), 1275-81 | 33 1C58 |
| 213 | Polycyclic Aromatic Hydrocarbons | Liquid Chrom. | | Oils | Data for 27 Hydrocarbons | Goldstein, G., J. Chromatogr., 1976, 126, 61-72 | 33 1C59 |
| 214 | Aromatic Hydrocarbons | Elution Chromo | | Hydrocarbon Mixtures | Polystyrene Gel Retention Indices for 83 Cpds. | Popl, M. et al., J. Chromatogr., 1977, 136, 195-204 | 33 2C37 |
| 215 | Polycyclic Aromatic Hydrocarbons | L. C. | | Hydrocarbon Mixtures | Phthalimidopropyl Silane on Silica Gel | Hunt, D. et al., J. Chromatogr., 1977, 130, 320-3 | 33 2C38 |
| 216 | Polycyclic Aromatic Hydrocarbons | Thin Layer Chromo | | Hydrocarbon Mixtures | Polyamide Coating | Bories, G., J. Chromatogr., 1977, 130, 387-9 | 33 2C46 |
| 217 | Polycyclic Aromatic Cpds. | I. R. Fourier Transform, Matrix Isolation | .5 ug | Hydrocarbon Mixtures | | Mamantov, G. et al., Anal. Chem., 1977, 49, (1), 86-90 | 33 2C42 |
| 218 | Polycyclic Aromatic Cpds. | Phosphorescence | 1 ng | Hydrocarbon Mixtures | | Tuan, V. et al., Talanta, 1977, 24, (2), 146-8 | 33 2C43 |
| 219 | Polycyclic Hydrocarbons | M. S. Photo Ionization | | Complex Mixtures | | Severin, D., Erdoel Kohle Erdgas Petro Chem Brennst-Chem, 1977, 30, (2), 87 | 33 2C47 |
| 220 | V | A. A. | | Petroleum | Effects of added Alkali metals | Lang, I. et al., Anal. Chim. Acta., 1977, 88, (2), 313-8 | 33 2C49 |
| 221 | Polycyclic Aromatic Cpds. | Thin Layer Chromo | Benzo(a) Pyrene 1 pg | Hydrocarbon Mixtures | Acetylated Cellulose | Woidich, H. et al., Chromatographia, 1977, 10, (3), 140-6 | 33 3C40 |
| 222 | Ti | A. A. | .03 PPM | Oil, Lubricating | | Saba, C. and Eisentraut, K., Anal. Chem., 1977, 49, (3), 454-7 | 33 3C49 |
| 223 | Vl, Ni | A. A. | | Petroleum | Effect of Halogen | Sebor, G. and Lang, I., Anal. Chim. Acta., 1977, 89, (1), 221-3 | 33 3C50 |
| 224 | Polynuclear Aromatic Cpds. | T. L. C. Fluor. | | Oil, Shale | | Hurtubisf, R., Anal. Chim. Acta., 1977, 89, (2), 377-382 | 33 4C43 |
| 225 | Polycyclic Aromatic Hydrocarbons | L. C. Fluor. | 5 pg | Hydrocarbon Mixtures | Fluorescence Detector | Johnson, E. et al., J. Chromatogr., 1977, 134, (1), 107-119 | 33 4J17 |
| 226 | Polycyclic Aromatic Hydrocarbons | L. C. U. V. Detector | | Hydrocarbon Mixtures | Separation and Detection | Thoms, R. and Zander, M., Fresenius' Z. Anal. Chem., 1976, 282, (5), 443-5 | 33 5C37 |
| 227 | Polynuclear Hydrocarbons | G. C. | | Hydrocarbon Mixtures | Cadmium Chloride Column | Guha, O. and Goswami, T., J. Chromatogr., 1977, 135, (2), 359-65 | 33 5C38 |
| 228 | Aromatic Amines | L. C. | Pico Moles | Hydrocarbon Mixtures | Cation Exchange Resin | Mefford, I. et al., Anal. Chem., 1977, 49, (4), 683 | 33 5C39 |
| 229 | Hetrocyclic Nitrogen Cpds. | T. L. Chrom Fluor. | | Hydrocarbon Mixtures | Cu I Spray | Wagner, H. and Lehmann, H., Fresenius' Z. Anal. Chem., 1977, 283, (7), 115-9 | 33 5C40 |
| 230 | Alkyl Pyridines | G. C. | | | Ret. Indices for 39 Cpds. | Satcs, V. et al., Zh. Anal. Khim., 1977, 32, (4), 797-806 | 33 5C41 |
| 231 | Benzimidazoles & Oxadiazoles | Paper Chrom | | | $R_F$ Values for 18 Cpds. | Hofmann, H., and Splinder, J., Z. Chem., 1977, 17, (5), 109-81 | 33 5C43 |
| 232 | Ni | A. A. | | Oil, Heavy Crude | Carbon Rod Atomizer | Labrecque, J. et al., Appl. Spectrosc., 1977, 31, (3), 207-10 | 33 5C45 |
| 233 | Separation | Gel. Per Chromo | | Heavy Petroleum Fraction | Elution.<br>Rapid,<br><30 min. | Hodgin, J. et al., J. Chromatogr., 1977, 135, (2), 514-20 | 33 5C46 |

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## SEPARATION & IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM RESIDUALS (CONT'D)

| | Determination of | Method of Analysis | Approximate Limits & Sensitivity | Matrix | Notes | Reference | Analytical Abstracts |
|---|---|---|---|---|---|---|---|
| 234 | Separation | L. C. | | Residual Oils | Applicability<br>Reproducibility | Halasz, T., Endoel Kohle Erdgas Petrochem. Brennst-Chem., 1977, 30, (5), 228 | 33 5C58 |
| 235 | Carbonyl Cpds. | L. C. | Quan. | Hydrocarbon Mixtures | 24-Dinitro Phenyl Hydrazone Derivatives<br>U. V. Detection | Selim, S., J. Chromatogr., 1977, 6, (2), 271-7 | 33 6C21 |
| 236 | Polycyclic Aromatic Hydrocarbons | Fluor.<br>Low-Temp. | 10 pg | Hydrocarbon Mixtures | Run at 15 °K | Stroupe, R. et al., Anal. Chem., 1977, 49, (6), 701-5 | 33 6C45 |
| 237 | Polycyclic Hydrocarbons | Mass. Spec.<br>Field Desorption | Quan. | Hydrocarbon Mixtures | | Pfeifer, S. et al., Fresenius 'Z. Anal. Chem., 1977, 284, (3), 193-5 | 33 6C46 |
| 238 | Pb | A. A. | 2 ug/l | Naphtha | | Madec, M. and LaVilla, F., Rev. Dist. Fr. Pet., 1976, 31, (4), 687-781 | 33 6C51 |
| 239 | Aromatic Hydrocarbons | Elution Chrom U. V. | | Oil,<br>Coal | | Rusin, A., Chem. Anal. (Warsaw), 1977, 22, (2), 255-64 | 33 6C55 |
| 240 | Separation | Water Extraction<br>Gel P. C. | – | Oil, Crude | Used for Characterization of Crudes Separated Aromatics & Phenolics | Larson, R. and Weston, J., Bull. Environ. Contam. Toxical, 1977, 16, (1), 44-52 | 33 6H45 |
| 241 | Metals | Separation | | Residual Oils | Removal with Molten Tin | Miyadera, H. et al., Japan Kokai, Patent # 75702 | CA Condens 72 - 76 |

# APPENDIX K

## REVIEW ARTICLES - SEPARATION AND IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM

The references to review articles in Appendix K are taken from "Analytical Abstracts" as published since 1954.

## REVIEW ARTICLES - SEPARATION AND IDENTIFICATION OF HAZARDOUS MATERIALS IN PETROLEUM

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| 3. | Noar, J., Inst. Petrol, Rev., 1955, 9, 209-212. "Notes on the uses of emission spectroscopy in the petroleum industry. II, Applications to petroleum analysis." Oils, gas oils, residual oils, metals, deposits, ashes, catalysts, etc. 49 references. | 3 | 2155 |
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| 5. | Williams, R., Spectrochim. Acta, 1959, 14, 24-44. "Nuclear magnetic resonance in petroleum analytical research." About 500 spectra collected and discussed. | | |
| 6. | Buzon, J., Bull. Soc. Chim. France, 1963, (3), 526-531. "Recent applications of gas phase chromatography to the analysis of petroleum products." 165 references. | 11 | 1022 |
| 7. | Chu, Shu-Kung and Chen, Ming-Tang. J. Chinese Chem. Soc., 1963, 10 (2-3), 101-117. "Analysis of Taiwan petroleum coke." Determination of Al, Mg, V, Ti, Fe, Ca, Mo, Cu, Mn, Cr, Co, Ni and B. 27 references. | 11 | 5586 |
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| 9. | Killer, F. and Amos, R., J. Inst. Petrol., 1966, 52, 315-328. "Use of thin layer chromatography in the analysis of petroleum products." 54 references. | 15 | 837 |
| 10. | Mostyn, R. and Cunningham, A., J. Inst. Petrol., 1967, 53, 101-111. "Some applications of atomic absorption spectroscopy to the analysis of fuels and lubricants." 28 references. | 15 | 3418 |
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| 13. | "Procedings of the Second International Symposium on the Utilization of Gas Chromatography and Associated Methods in the Petroleum and Petrochemical Industries. Bratislava, Czechoslovakia. December 1969." J. Chromat., 1970, 51. | 19 | 4697 |
| 14. | "Procedings of the Third International Symposium on the Utilization of Gas Chromatography and Associated Methods in the Petroleum and Petrochemical Industries. Bratislava, Czechoslovakia. May 1971." J. Chromat., 1972, 65 (1). | | |

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| 15. | "Informal Symposium of the Gas Chromatography Discussion Group of the Institute of Petroleum." J. Chromat., 1972, 10, (7), 425-429. | 23 | 4487 |
| 16. | Severin, D. et. al., "Mass spectrometric analysis of high boiling mineral oil fractions." Erdocl Kohle Erdgas Petrochem. Brennst-Chem., 1972, 25 (9), 514-521. Results for 85 hydrocarbons and 10 lubricating oils. | 24 | 2255 |
| 17. | "Informal Symposium of the Gas Chromatography Discussion Group of the Institute of Petroleum, London. J. Chromat. Sci., 1972, 10 (12), 705-707. | 24 | 3309 |
| 18. | Aczel, T., Rev. Analyt. Chem., 1972, 1 (3), 226-261. "Applications of high-resolution mass spectrometry to analysis of complex aromatic mixtures derived from petroleum and coal liquids." 26 references. | 25 | 2359 |
| 19. | "Trace Elements in Fuel Chemistry." Papers presented at the 166th National Meeting of the A.C.S., Chicago, Illinois. August 1973. Includes inter lab evaluation of ref. materials. |  |  |
| 20. | Camin, D. and Raymond, A., "Chromatography in the petroleum industry." J. Chromat. Sci., 1973, 11 (12), 625-638. 81 references. | 27 | 508 |
| 21. | Amos, R., "Thin layer chromatography in the heavy organic industries: A review." Talanta, 1973, 20 (12). 1231-1260. Includes petroleum industry. 118 references. | 27 | 767 |
| 22. | Milne, G. and Lacey, M., "Modern ionization techniques in mass spectrometry." CRC Crit. Rev. Analyt. Chem., 1974, 4 (1), 45-104. 325 references. | 28 | 3175 |
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| 24. | Brown, C. et. al., Appl. Spectrosc. Rev. 1975, 9 (2), 223-248. "Applications of infrared spectroscopy in petroleum analysis and oil-spill identification." Composition of petroleum in relation to its I.R. bonds. 136 references | 29 | 6C39 |
| 25. | "Symposium: Chemistry, Occurence and Measurement of Polynuclear Aromatic Hydrocarbons. Chicago, Illinois. August 1975." Prepr. Div., Petrol. Chem. Am. Chem. Soc., 1975, 20 (4). | 30 | 5A1 |
| 26. | Walton, H., Sepn. Purif. Meth., 1975, 4 (2), 189-214. "Chromatography of non-ionic organic compounds on ion-exchange resins." 69 references. | 31 | 5C2 |
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| 28. | Book - Hafstader, R. et. al. Ed. "Analysis of Petroleum for Trace Metals. "Symposium. Amer. Chem. Soc., Washington, D.C., 1976. | 33 | 3C85 |
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